Moose
Management Report
of survey-inventory activities
1 July 1999–30 June 2001

Carole Healy, Editor
Alaska Department of Fish and Game
Division of Wildlife Conservation
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ADF&G

Please note that population and harvest data in this report are estimates and may be refined at a later date.

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If used in part, the reference would include the author's name, unit number, and page numbers. Authors' names and the reference for using part of this report can be found at the end of each unit section.

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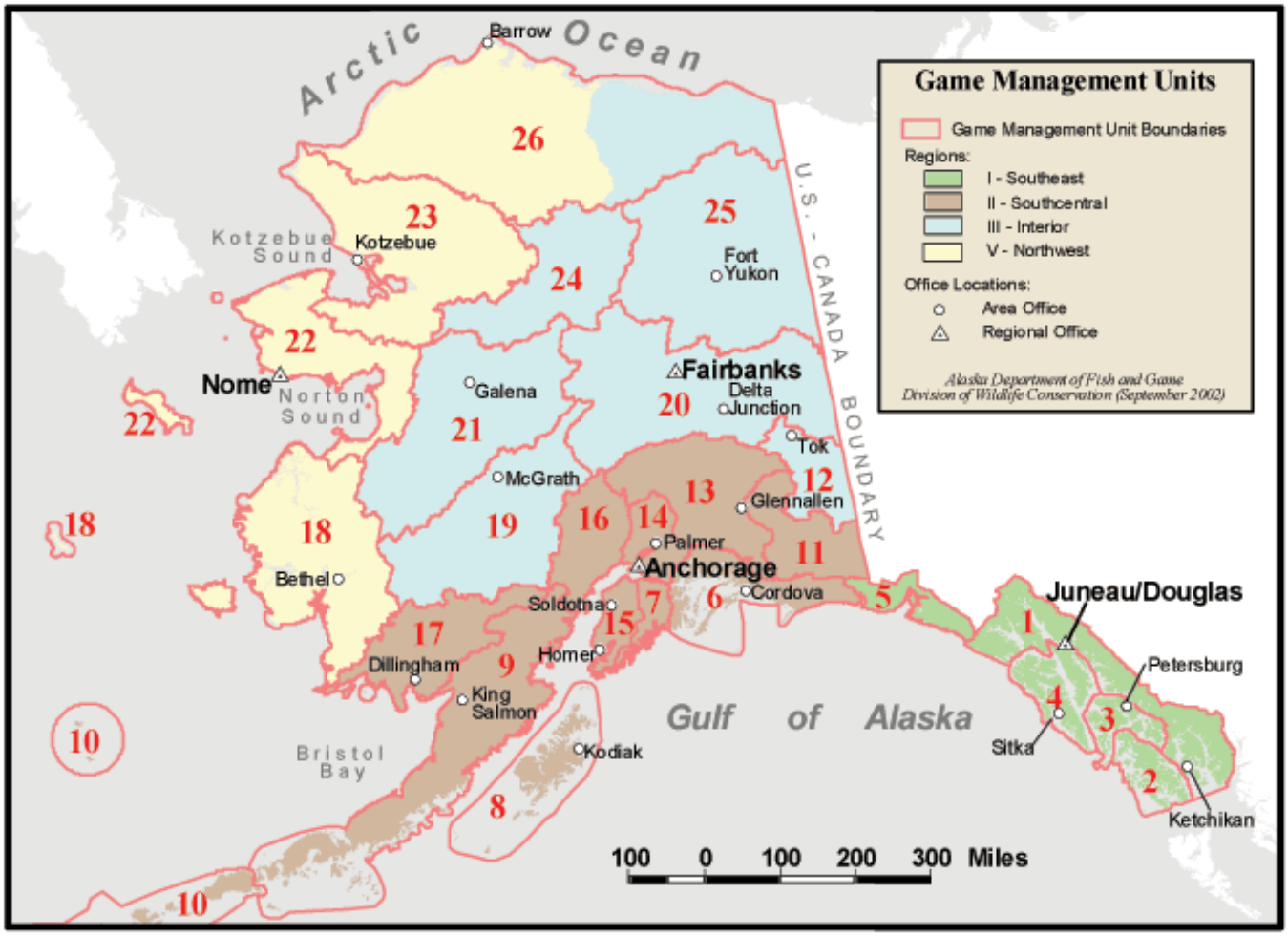
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Glennallen
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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 19 (36,486 mi^2); 21A and 21E (23,270 mi^2)

GEOGRAPHIC DESCRIPTION: All of the drainages into the Kuskokwim River upstream from Lower Kalskag; Yukon River drainage from Paimiut upstream to, but not including, the Blackburn Creek drainage; the entire Innoko River drainage; and the Nowitna River drainage upstream from the confluence of the Little Mud and Nowitna Rivers.

BACKGROUND

Moose are a relatively recent faunal addition to western Interior Alaska. According to oral history, their initial discovery was apparently sometime after the turn of the twentieth century. As recent as the 1970s, populations were probably at record highs. Currently, moose are found throughout this area, with the exception of the rugged peaks of the Alaska Range. The major factors influencing moose abundance in the area include predation, weather, and hunting. Hunting pressure is thought to be moderate except in a few easily accessible areas. Failure to report harvests, particularly by local residents, is a chronic problem.

Unit 19, as well as Units 21A and 21E, can be conveniently divided into 2 regions that have distinct differences in moose habitat, user access, and hunting practices. Units 19A, 19D, and 21E are generally lower elevation areas accessible by boat. Hunters generally have been local residents living and hunting for food in Unit 19, Unit 21, or adjacent Unit 18. Units 19B, 19C, and 21A are generally higher elevation areas where access is largely restricted to aircraft. Few people live in these areas, and those traveling there to hunt have been mainly seeking large bulls for their trophy quality, although acquisition of meat has been an important consideration as well.

Aerial composition surveys have been the primary means of assessing population status and trend in this large area. There is a history of surveys dating back several decades. Unfortunately, these data are of limited value because of inconsistencies in survey areas and methods. The data is also subject to annual variations in weather conditions affecting moose movements and the timing and quality of surveys.

Historical moose survey information is limited. A combination of changes in moose survey techniques and the logistical challenges of moose surveys in remote areas has resulted in a

discontinuous and often incomparable moose count database. Since the general standardization of survey techniques in the 1980s, we have attempted to establish trend count areas and survey areas to balance the information needs of management with fiscal limitations.

MANAGEMENT DIRECTION

Subunit boundaries within the area were designed to provide for 2 major uses of moose. The lowland areas along the Kuskokwim River (Units 19A and 19D) and along the Yukon and lower Innoko Rivers (Unit 21E) have been managed in an attempt to provide a sustained, relatively high harvest of moose. The higher elevation portions (Units 19B, 19C, and 21A) have been managed largely for trophy quality animals. Because topography directly affects access, management of the area should continue to be based on these premises.

MANAGEMENT OBJECTIVES

- Annually assess population status, trend, and bull:cow ratios in portions of the area where harvest levels make significant impacts on moose populations.
- Maintain an annual average antler spread measurement of at least 48 inches in Units 19B, 19C, and 21A.
- Assess accuracy of harvest reporting in selected portions of the area.
- Encourage landowners to reduce fire suppression efforts on wildfires that do not threaten human life, property, or valuable resources, so that fire can fulfill its natural role in maintaining young, highly productive, and diverse habitats.

METHODS

We conducted population composition and trend surveys in selected portions of the area using standard aerial survey techniques (Gasaway et al. 1986). These surveys were flown in 50–100 mi^2 sampling areas using fixed-wing aircraft. Sampling areas had fixed boundaries and were flown in the fall after sufficient snowfall has occurred, but prior to antler shedding by bulls. Surveys were usually flown at a search intensity of 3–5 minutes/mi^2, depending on the habitat type and the associated visibility.

We estimated population size in a portion of Unit 21E in February 2000 using the Geostatistical Population Estimator (GSPE) (Ver Hoef 2001). We also estimated populations in a portion of Unit 19D East in November 2000 and again in October 2001. The survey area included the portion of Unit 19D in the Kuskokwim River drainage upstream from the Selatna River, not including the Takotna River drainage upstream from its confluence with the Nixon Fork.

Calf twinning surveys were conducted during May and June in Unit 19D along the Kuskokwim River, in Unit 19A along the Holitna River, and in Unit 21E. They were conducted much like the fall surveys described above, except they were flown beginning in mid-May when moose calving starts and continued through early June when leaf out limits sightability. These surveys were

completed in fixed geographical areas, however search effort was greatest in meadows and low shrub areas with high sightability.

Harvest was monitored by requiring hunters to acquire moose harvest tickets and to report residency, effort, location of hunt, transportation method, commercial services used, success, sex of kill, and antler width. In a portion of Unit 19D, a registration hunt was established for the fall 2001 season. The purpose was to get better hunter data and to collect teeth from harvested moose to assess the age structure of the harvest.

Population and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY99 = 1 Jul 1999–30 Jun 2000).

MANAGEMENT PLANNING

During RY99 the Unit 19D East moose population situation gained political attention and the Governor appointed a group referred to as the Unit 19D East Adaptive Management Team to develop recommendations for the department to address the moose population declines. This team was made up of 2 members representing local users, 2 members representing conservation interests, and the Director of Wildlife Conservation and the McGrath area biologist representing the department. This team met several times from June 2000 to February 2001 and presented a report including recommendations for regulatory changes and information gaps to the Commissioner of Fish and Game. Since February 2001 the group met once to review results of the research project's first year.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

We conducted trend area counts in every subunit except Unit 19B during RY99–RY00. We completed spring population estimates in Unit 21E in February 2000, in Unit 19D in November 2000, and Unit 19D in October 2001.

Unit 19A. The Unit 19A moose population was stable to declining, based on trend data from the Holitna/Hoholitna trend count area and a density estimate in a portion of the Aniak River drainage. Trend area information indicates observable moose numbers increased from the late 1980s until RY94, when peak numbers of total moose and moose per hour were observed (Table 1a). Trend counts during RY96 and RY97 indicated a steady decrease in total numbers of moose observed. Trend surveys were not conducted during RY98, RY99 and RY00, because of poor survey conditions and manpower challenges. The November 2001 trend count indicated very low numbers including very low bull:cow ratio (6:100), low calf:cow ratios (8:100), and the lowest number of total moose ever recorded. Explanations for some of the decline could have been the shallow snow and relatively temperate late fall weather causing atypical distribution. The February 2001 density estimate was 0.70 moose/mi^2 (±21%, 90% CI) indicating a low to moderate late winter moose density for western Interior Alaska. These data indicated poor calf survival to fall, and poor overwinter adult survival. Based on local hunter and trapper

information, predation by wolves and increasing incidents of grizzly bears in the area could be the primary factors.

Unit 19B. No trend count data or population estimates are available from Unit 19B. Moose trend count areas have been sporadically established, but were abandoned because early winter snowfall conditions varied greatly, influencing moose distribution and causing extreme variations in the data. However, the moose population in Unit 19B appeared to be stable to declining, based on harvest data and information from local hunters and guides.

Unit 19C. The moose population in Unit 19C was stable based on trend counts (Table 1b). Trend data through the fall of 1996 showed a population increase. Composition ratios were very similar during RY97 and RY99, however the total number of observed moose declined. No survey was completed during RY00, due to poor conditions. The RY01 fall survey indicated a continued slow decline in the bull:cow ratio and a stable calf:cow ratio. For the first time, the yearling bull:cow ratio showed a decrease, possibly indicating lower calf survival. The total number of moose observed during fall 2001 was similar to other years. However, the moose per hour information was similar to the fall 1999 trend area count. The decline in the bull:cow ratio was due to declining overall numbers and, based on hunter and trapper information, poor calf survival primarily due to predation by bears and wolves.

Unit 19D. The moose population in Unit 19D stabilized at low densities during this reporting period (RY99–RY00). The low densities are indicative of the low-density equilibrium described by Gasaway et al. (1992) for wolf–bear–moose systems in Alaska and the Yukon. The GSPE completed in November 2000 in Unit 19D East (5200 mi^2) indicated overall moose density was 0.16 moose/mi^2 (±33%, 95% CI). The October 2001 GSPE, completed in the same area as the 2001 survey, was 0.43 moose/mi^2 (±30%, 95% CI). The higher 2001 count was attributed to several possible factors including: higher survey intensity, better sightability conditions, and randomly drew more productive sample units.

Unit 19D also contains the well-established Candle–Wilson composition/trend count areas. In this portion of Unit 19D East, survey information indicated a decreasing bull:cow ratio from 18:100 during RY98 to 6:100 during RY01. Calf:cow ratios fluctuated from 22–52 calves:100 cows. Overall, observed numbers of moose have fluctuated between 56 and 95 total moose from RY96–RY01 (Table 1c).

Unit 21A. The moose population in Unit 21A was stable to declining. Trend data was not collected on a regular basis in the unit. However, anecdotal winter observations by trappers indicated a decline in the overwintering population. Also, staff from the Innoko National Wildlife Refuge estimated a density of 0.64 moose/mi^2 (±29.6%, 90% CI) in the refuge portion of Unit 21A and into Unit 21E. However the results of this estimate are not comparable to our density measures due to differences in technique.

Unit 21E. The moose population in Unit 21E is believed to have been stable during RY99–RY00. No surveys were conducted in the Holy Cross trend area during RY99–RY00 due to poor survey conditions (Table 1d). Our February 2000 GSPE in a 5070-mi^2 portion of Unit 21E indicated a density of 1.0 moose/mi^2 and provided a baseline for further population monitoring.

Population Composition

In Unit 19A, bull:cow ratios from 10 fall surveys between RY76 and RY97 in the Holitna River drainage showed some deterioration of the bull:cow ratio and the RY01 survey indicated further decline (Table 1a). Intense hunting pressure in that area, along with predation from bears and wolves probably caused some of the declining ratios. Fall calf:cow ratios fell precipitously in this area indicating low calf survival. This substantiated data was gathered during a February 2000 survey along the Hoholitna River. The survey indicated calf (9-mo-old) survival was <5% (7/152), which was very low. The total number of moose observed was also low during the survey indicating a declining population in that area. Unit 19B composition data is largely unknown. However, harvest data from the unit indicated a decline in the number of bulls and specifically in the number of large bulls. Anecdotal information collected from several guides indicated a reduction in the number of bulls available over the past few seasons.

Unit 19C is represented by the Farewell trend count area. In 11 surveys conducted in the Farewell area from RY87 to RY01, notable increases in the moose population were seen through RY96. Data indicated a general decline in the bull:cow ratio from RY97 through RY01. Yearling bull:cow ratios remained relatively steady from RY90–RY99, however during the RY01 survey, data indicated a decline in the yearling bull:cow ratio. Calf:cow ratios appear to be remaining stable (Table 1b).

In Unit 19D the moose population continued to maintain low densities. Bull:cow ratios in the Candle–Wilson count area were low and variable (6–18:100) from RY96 to RY01, but the overall trend was down. Yearling bull:cow ratios also declined from RY96 to RY01. Fluctuations could have been due to a combination of decreasing sample size and declining number of bulls (Table 1c). Calf:cow ratios likewise were highly variable (22–52:100).

Units 21A and 21E sex and age composition data were not gathered from the Holy Cross trend count area during RY99–RY00 due to poor survey conditions during the fall. A spring density survey estimated the percent calves at 16.1%, indicating good production and survival to February.

MORTALITY

Harvest

Seasons and Bag Limits.

In Unit 19A within the Lime Village Management Area, residents could take 2 moose of either sex by Tier II permit during 10 August–25 September or during 20 November–31 March. The Lime Village Management Area was closed to nonresidents.

Unit 19A outside of the Lime Village Management Area and upstream of the Kolmakof and Holokuk Rivers had a bag limit for residents of 1 bull during 1–20 September or 20–30 November, and either sex could be harvested during 1–10 February. Nonresidents could take 1 bull having antlers at least 50 inches or at least 4 brow tines on 1 or both sides during 1–20 September.

Unit 19A outside of the Lime Village Management Area and downstream of the Kolmakof and Holokuk drainages had resident open seasons of 1–20 September, 20–30 November, and 1–10 February for any bull. The February season in RY00 was closed by emergency order in all of Unit 19A. During RY01 the February season was closed by emergency order upstream of the Holokuk and Kolmakof. Nonresidents were allowed to harvest bulls with antlers 50 inches or greater or at least 4 brow tines on at least 1 side during 1–20 September.

Units 19B and 19C had resident seasons of 1–25 September for any bull. Nonresidents were allowed to harvest bulls with 50-inch plus antlers or antlers with 4 or more brow tines on at least 1 side during the same time period. In addition, a registration hunt for resident hunters was established by the Board of Game in Unit 19C for antlered bull moose during 15 January–15 February.

In Unit 19D during RY99 along the Kuskokwim River upstream from and including the Selatna River drainage, resident hunters could take 1 bull moose during 1–25 September or 1–31 December. Nonresidents were not allowed to participate in the hunt. An additional 20–31 August season was available within the area upstream of Big River, south and east of the North Fork Kuskokwim River. The December season was closed by emergency order. In the remainder of Unit 19D, residents were allowed 1 bull during 1–25 September or 1–31 December. Nonresidents had to comply with the 50-inch antler regulation and could hunt only during 1–25 September.

In Unit 19D during RY00 along the Kuskokwim River upstream from but not including the Selatna River and Black River drainage, resident hunters could take 1 bull moose during 1–20 September or 1–15 December. Nonresidents were not allowed to participate in the hunt. An additional 20–31 August season was available within the area upstream of Big River, south and east of the North Fork Kuskokwim River. The December season was closed by emergency order. In the remainder of Unit 19D, residents were allowed 1 bull during 1–20 September or 1–31 December. Nonresidents were not allowed to hunt.

In Unit 19D during RY01 along the Kuskokwim River upstream from but not including the Selatna River and Black River drainage, resident hunters could take 1 bull moose during 1–20 September or during 1–15 December by registration permit (RM650). Nonresidents were not allowed to participate in the hunt. An additional 20–31 August season was available within the area upstream of Big River, south and east of the North Fork Kuskokwim River, also by the same registration permit. The December season was closed by emergency order. In the remainder of Unit 19D, residents were allowed 1 bull during 1–20 September or 1–31 December. Along with resident hunters, nonresidents were allowed to hunt in a small area including the Cheeneetnuk and Gagaryah River drainages, excluding a corridor extending 2 miles north of the Swift River. This nonresident area was open 1–20 September for bulls with 50-inch antlers or at least 4 brow tines on 1 side.

Unit 21A resident hunters could harvest 1 bull during 5–25 September or in November. Nonresident hunters could harvest 1 bull during the 5–25 September season with a 50-inch minimum antler or antlers with 4 or more brow tines on 1 side.

Unit 21E resident hunters could hunt any bull 5–25 September, or any moose 1–10 February except moose could not be taken within one-half mile of either the Yukon or Innoko Rivers during February. Nonresidents had the same September season, but had to select a bull with at least 50-inch antlers or antlers with 4 or more brow tines on 1 side.

Alaska Board of Game Actions and Emergency Orders. Unit 19D season dates were changed during the spring 2000 Alaska Board of Game meeting for RY00. We proposed reducing the season to 15 days in September and eliminating the December season, except in the remainder of the unit downstream of the Selatna River. The goal was to slow the decline in bull:cow ratios. The board passed a 5-day season reduction during the fall season, throughout the unit, and shortened the December season upstream of the Selatna River to 1–15 December. Included with these changes was a complete elimination of the nonresident season that had existed below the Selatna River drainage.

During a special May 2001 Board of Game meeting in Fairbanks, the board made several changes to the moose season in Unit 19D East. First, they expanded the size of the area that restricted aircraft use for moose hunting to include all the Takotna River drainage and to include the Kuskokwim drainage south of the Big River to the Selatna River and Black River drainages. They created a moose registration hunt in Unit 19D East to allow the department to collect more precise information on hunter effort and harvest. The board passed a proposal to open a small area for nonresidents in the Cheeneetnuk and Gagaryah River drainages, excluding a corridor extending 2 miles north of the Swift River. The board had closed that area during the spring 2000 meeting.

During the spring 2002 Board of Game meeting in Fairbanks, several changes were made. In Unit 21A in the Nowitna River drainage, the nonresident season was shortened to 5–20 September to align with the lower Nowitna River nonresident season. In Unit 19A the board passed a proposal prohibiting hunting for moose and caribou by nonresidents within 2 miles of either side of all rivers in Unit 19A from Kalskag to the Holitna River. This was a compromise between the area guides and local subsistence hunters that had proposed closing the unit entirely to nonresident hunters.

The department supported shortening the fall season in Units 19A and 19B, but the board decided to maintain the current seasons. They passed a proposal to reduce the February season in that portion of Unit 19A upstream of the Holokuk and Kolmakof drainages from 1–10 February to 1–5 February and changed the bag limit from any moose to bulls only, but maintained the current season of 1–10 February in the portion of Unit 19A downstream from and including the Holokuk and Kolmakof drainages. The board extended the Holitna/Hoholitna River Management area to include the Aniak River drainage, requiring hunters who fly into Unit 19B and take big game to also be flown out of Unit 19B. These hunters can no longer float into Unit 19A. The board passed a proposal for the August portion of the Unit 19D moose season changing the border from the riverbank to the drainage, allowing hunters on the North Fork Kuskokwim River to hunt both banks. The board eliminated the December season in Unit 19D East and reduced it to 1–15 December in the remainder of the unit. The board passed a department-amended version of a public proposal to reduce the season in Unit 19C to 1–20 September. The original proposal

was to restrict resident hunters to bulls with 50-inch antlers and increase the antler restrictions for nonresidents to 55 or 60 inches.

Hunter Harvest. Hunter harvest is reported in Tables 2a–2h. Reported annual moose harvest in Unit 19A declined during RY99–RY00. The average reported annual harvest during RY96–RY00 was 139 (Table 2b). The majority of moose reported taken during RY96–RY00 were bulls (93%), with light cow harvest in February. Because reporting rate by local hunters was low, actual harvest rates are a minimum of 33% greater.

Reported annual harvests in Units 19B and 19C were probably much closer to actual harvest than in Unit 19A. They averaged 149 and 139 moose, respectively, during RY96–RY00 (Tables 2c and 2d). This also indicated a slight decline from RY97–RY98. In Unit 19D compliance with reporting requirements was estimated to be poor. Reported kill averaged 94 (Table 2e) during RY96–RY00. This was a decline from the previous 5-year average of 102 moose.

In Unit 21A reported moose harvests were stable during RY96–RY00, with 116 animals taken on average (Table 2g). In Unit 21E reported harvests were stable during RY96–RY00. The reported harvest of 210 moose in RY97 was the highest on record, probably reflecting better compliance with reporting requirements and some increases in harvest (Table 2h).

Permit Hunts. Beginning with the RY90 season, a Tier II drawing permit hunt was established for moose hunting in the Lime Village Management Area in Unit 19A. During RY90, 10 permits were issued with a harvest quota of 25 either-sex moose. The bag limit was changed to 28 moose with a limit of 2 per permit for RY93. Reported harvests were light, for example the RY98 hunt included 7 moose killed, 1 unsuccessful hunter, and 7 permittees that did not attempt to hunt (Table 3). There was also a federal permit hunt in the same area, with a harvest quota of 40 moose.

In Unit 19C during RY97 a winter registration hunt was established. The season is 15 January–15 February and excludes the use of aircraft. Hunter participation has been low, however, interest by Nikolai residents has increased. The average reported harvest has been 2 moose, with from 1 to 6 hunters getting the permits.

In RY01 a registration hunt was put into place in Unit 19D East. This registration hunt was a result of the Unit 19D East planning team meetings. The goal was to more accurately assess hunter effort and success in Unit 19D East. Moose teeth collected from successful hunters in this hunt will be processed and aged to examine the age structure of the population. During the first season 289 permits were issued and 65 bulls were taken (Table 3).

Antler Size. The average antler size for bulls harvested in RY96–RY00 in Units 19B was 53 inches, in 19C, 51 inches, and 21A, 50 inches. These subunits had a high proportion of guided and unguided nonresident hunters who were required to take bulls with a minimum antler size. The average antler size for RY96–RY00 in the Units 19A was 43 inches, in 19D it was 46 inches and 21E, 43 inches. These subunits had a high proportion of local resident hunters who were not required to take bulls with a minimum antler size. Average antler size within individual subunits was relatively stable during RY96–RY00.

Hunter Residency and Success. Nonlocal residents accounted for the major portion of the reported harvests in Units 19A, 19C, and 21E, while the majority of hunters in Units 19B and 21A were nonresidents (Tables 4a–4h). In Unit 19D the majority of the hunters were local unit residents. This segregation by residence location was due to different means of access and access restrictions.

In Unit 19A hunter residency did not change dramatically during RY96–RY00. Hunters from throughout Unit 19 accounted for 28% of reporting hunters (RY96–RY00). Alaska residents from outside the unit accounted for 51% of reporting hunters. Nonresident hunters accounted for less than 12% (Table 4b). During RY96–RY00 Unit 19B hunters consisted of nonlocal Alaskan (35%) and nonresident (65%) hunters (Table 4c). Very few people live in the subunit. Hunters in Unit 19C were nonlocal Alaskans (57%) and nonresidents (43%). Unit 19D hunters were largely local residents (49%). Alaska residents from other areas made up an additional 36% of the reporting hunters. Nonresidents only accounted for about 15% of the hunters who reported during the previous 5-year period (Table 4e).

Unit 21A hunters consisted largely of nonlocals (21%) and nonresidents (79%) (Table 4g). Hunters reporting from Unit 21E were generally from 1 of 4 villages in the subunit (16%) or were nonlocal residents of Unit 18 (67%). The proportion of nonresidents was generally less than 10% but increased in RY96–RY00 to an average of 17% of all hunters in the subunit (Table 4h).

In Unit 19A the reported hunter success rate averaged 47% (37–54%) during RY96–RY00. In Unit 19B the reported hunter success averaged 38% (32–47%) during RY96–RY00. In Unit 19C the reported success rate averaged 54% (50–60%) during RY96–RY00. In Unit 19D the reported success averaged 51% (46–60%) from RY96–RY00. In Unit 21A the reported average success was 58% (47–65%) from RY96–RY00. In Unit 21E the average reported success was 78% (70–83%) during RY96–RY00.

Transport Methods. Transportation methods used by hunters are reported in Tables 5a–5h. As in previous years, the Units 19A, 19D, and 21E method of transport most commonly used was boat (RY00 data, 67%, 79%, and 79%, respectively) (Tables 5b, 5e and 5h). The use of aircraft for transportation was predominant during RY00 in Unit 19B with 90% and in 21A with 69% of all access (Tables 5c and 5g). In Unit 19C, transportation to the field for 98% of the hunters was usually by aircraft, however in RY98, hunters reported using aircraft 67% and ATVs and horses 31% (Table 5d). This happened because most hunters transported ATVs to the Farewell Station Airstrip and some guided hunters used horses. Differences in transportation methods in different areas were used to define the original unit boundaries to spatially separate user groups and hunting patterns. Therefore, local hunters were still largely separated from nonlocal hunters since the subunit boundaries were last adjusted in the early 1980s.

Other Mortality

Illegal harvests, defense of life or property kills, wounding loss, and funeral potlatch harvests probably account for an additional 150–200 moose deaths annually in Unit 19, and probably 100–150 additional kills in Units 21A and 21E. Of much greater importance to the dynamics of the moose population, however, is predation mortality. Based on trapper questionnaires, pilot

reports and data collected during moose surveys, predation on calves, yearlings, and adults by wolves has been substantial in recent years, as has calf predation by black bears.

HABITAT

Assessment

It is unlikely the moose population is limited by the available habitat. In Alaska, optimal moose forage is generally associated with willow bands, and in seral growth stages following wildfires. In Unit 19D East, over 2300 linear miles of riparian habitat is maintained by shifting rivers in a wide band along the Kuskokwim River and its major tributaries. Additional riparian habitat exists along smaller creeks and around hundreds of boreal lakes and ponds. Limited suppression of naturally occurring wildfires has created a mosaic of vegetation successional stages. During most summers, hundreds of square miles of boreal forest burns in small isolated fires throughout the area, creating increased potential for rejuvenation of moose winter forage plants. In addition, climax stands of subalpine willow persist in bands around the treeline of the boreal forest in the hills along the north side of the Kuskokwim drainages.

A February 2000 browse survey in Unit 19D near McGrath indicated many of the riparian willows were beginning to outgrow the browsing pressure. The 1999–2000 snowfall in the same area was greater than normal, forcing more moose onto the riparian willow bars. Substantial browsing was documented in these areas.

Enhancement

We continued efforts to document browse utilization on heavily used winter ranges along the Kuskokwim River. We also continued habitat enhancement efforts. Close cooperation with Alaska Department of Natural Resources Division of Forestry (DNR Forestry) fire management personnel resulted in relatively high-acreage burns in recent years. In cooperation with DNR Forestry we finished a prescribed fire plan for portions of Unit 19C in the Farewell area. Spring flooding conditions along the Kuskokwim River produced a substantial ice-scouring event that will help rejuvenate willow stands that had begun to grow out of reach of moose. Wildfires consumed approximately 325,000 acres in Units 19D, 21A and 19A in summer 2002.

CONCLUSIONS AND RECOMMENDATIONS

Populations over the reporting area were generally stable to declining, with considerable variation both within and between years. Regulatory year 2001 data indicated potential declining populations in all subunits surveyed except Unit 19D, where the population appears to have stabilized at low densities. Unit 19D was the only area that indicated a stable population compared to the previous reporting period in observed numbers. However, the bull:cow ratios in the trend area continued to decline. Calf:cow ratios were stable.

We completed density estimates in Units 21E, 19A, and 2 (2000, 2001) in Unit 19D. This will help us further assess the status of the populations. The fall weather conditions, along with fiscal and manpower challenges, continued to plague the McGrath moose survey–inventory program. Annual data collection efforts (trend and composition counts) in as many units as possible are the best and most cost-effective way to assess yearly changes in population composition and to

monitor population trends. During the next reporting period, with a new assistant area biologist position, we hope to gain ground on data collection.

We accomplished much of our objective to assess population status, trend and bull:cow ratios in portions of the unit where harvest levels make significant impacts on moose populations. However, efforts will be made during the next reporting period to improve data collection in the western portion of Units 19B, 19C and 21A to complete gathering baseline information. This is the first step in developing sound long-term management plans for moose in this area.

We met our objective to maintain an annual average antler spread measurement of at least 48 inches in Units 19B, 19C and 21A during this reporting period. This objective was designed as an index to the population status of large bulls and overall hunter success.

We made some progress on our objective to assess the accuracy of harvest reporting in portions of the area. We reviewed subsistence harvest surveys and compared them to reported harvests. During the next reporting period efforts will be made to implement a system to better assess reporting rates in selected areas, primarily Units 19A, 21E. These units have historically poor reporting and have sparked increasing debate over the population levels, trends, and the impact of all sources of mortality, including hunting.

We accomplished our objective to encourage wildfires. We maintained communications with DNR Forestry and the local Native corporations to advocate a "let burn" policy when possible. We also worked to alter some fire management zones from the full suppression category to modified or limited suppression to increase options for land managers. We will continue to revise the Farewell prescribed burn plan that was attempted in 2000. The prescription will be changed and hopefully this burn will occur in the next reporting period.

The objective to maintain an annual average antler spread measurement of at least 48 inches in Units 19B, 19C, and 21A was easily measured, so we could determine that the objective was met. Other objectives were not easy to quantify, therefore, could not be readily evaluated. During the next reporting period more quantifiable objectives will be formulated.

LITERATURE CITED

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Table 1a Holitna/Hoholitna Count Area (Unit 19A) fall aerial moose composition counts, regulatory years 1987–1988 through 2001–2002

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves	Percent calves	Adults	Moose	Moose/ hour
1987–1988	22	4	72	50	36	84	140	85
1988–1989	31	16	56	103	30	240	343	95
1989–1990	24	13	55	160	30	361	528	163
1990–1991	26	10	52	139	29	336	475	162
1991–1992[a]								
1992–1993	31	15	63	172	32	360	542	169
1993–1994[a]								
1994–1995	14	2	42	209	27	568	778	251
1995–1996[a]								
1996–1997	22	10	50	146	29	355	502	152
1997–1998	14	11	34	85	23	286	371	169
1998–1999[a]								
1999–2000[a]								
2001–2002	6	3	8	13	7	183	196	59

[a] No survey.

Table 1b Farewell Burn Count Area (Unit 19C) fall aerial moose composition counts, regulatory years 1987–1988 through 2001–2002

Regulatory year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves: 100 Cows	Calves	Percent calves	Adults	Moose	Moose/ hour
1987–1988	53	10	19	32	13	207	242	115
1988–1989	58	20	34	47	18	218	265	126
1989–1990	47	15	22	55	13	361	416	194
1990–1991	43	8	26	58	16	315	373	159
1991–1992	44	8	29	59	17	293	352	156
1992–1993	46	8	38	58	21	220	278	100
1993–1994[a]								
1994–1995	52	10	19	45	11	353	404	170
1995–1996[a]								
1996–1997	46	11	15	43	10	411	454	158
1997–1998	30	10	27	75	17	368	443	174
1998–1999[a]								
1999–2000[b]	33	11	27	42	17	206	248	86
2000–2001[a]								
2001–2002	25	3	25	76	17	377	454	81

[a] No survey.
[b] Fall 1999 – only 77.5% of the survey area flown.

Table 1c Candle/Wilson A, B, C, and D count areas (Unit 19D) fall aerial moose composition counts, regulatory years 1996–1997 through 2001–2002

Regulatory year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves: 100 Cows	Calves	Percent calves	Adults	Moose
1996–1997	18	7	34	19	21	66	95
1997–1998	13	6	52	25	32	54	79
1998–1999	13	4	34	13	23	43	56
1999–2000[a]							
2000–2001	9	2	29	16	20	61	77
2001–2002	6	2	22	14	17	68	82

[a] No survey.

Table 1d Holy Cross (Unit 21E) fall aerial moose composition counts, regulatory years 1987–1988 through 2001–2002

Regulatory year	Bulls: Cows	Yearling bulls:100 Cows	Calves: 100 Cows	Calves	Percent calves	Adults	Moose	Moose/ hour
1987–1988	19	9	43	150	26	420	570	83
1988–1989[a]								
1989–1990	31	12	45	148	25	432	584	161
1990–1991	29	7	51	211	28	536	758	253
1991–1992[a]								
1992–1993	26	5	22	67	14	412	483	163
1993–1994[a]								
1994–1995	29	9	63	216	32	444	674	234
1995–1996[a]								
1996–1997	30	11	34	158	21	604	762	186
1997–1998[a]								
1998–1999	26	11	35	77	22	276	353	103
1999–2000[a]								
2000–2001[a]								
2001–2002[a]								

[a] No survey.

Table 2a Unit 19 moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory year	Harvest by hunters: Reported M	(%)	F	(%)	Unk	Total	Estimated unreported[a]	Total
1986–1987	454	(98)	8	(2)	2	464	153	617
1987–1988	530	(97)	17	(3)	2	549	181	730
1988–1989	615	(98)	15	(2)	7	637	210	847
1989–1990	546	(99)	7	(1)	6	559	184	743
1990–1991	383	(95)	20	(5)	1	404	133	537
1991–1992	461	(97)	13	(3)	2	476	157	633
1992–1993	485	(95)	24	(5)	3	512	169	681
1993–1994	542	(99)	3	(1)	2	547	181	728
1994–1995	581	(99)	8	(1)	0	589	194	783
1995–1996	527	(99)	2	(1)	6	535	176	711
1996–1997	621	(99)	8	(1)	3	632	208	840
1997–1998	561	(99)	7	(1)	4	572	189	761
1998–1999	535	(97)	14	(3)	3	552	182	734
1999–2000	442	(97)	13	(3)	11	466	153	619
2000–2001	478	(100)	0	(0)	2	480	158	638

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2b Unit 19A moose harvest, 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters: Reported M	(%)	F	(%)	Unk	Total	Estimated unreported[a]	Total
1994–1995	160	(95)	8	(5)	0	168	55	223
1995–1996	137	(99)	2	(1)	2	141	47	188
1996–1997	174	(96)	8	(4)	2	184	61	245
1997–1998	136	(96)	6	(4)	0	142	47	189
1998–1999	130	(90)	14	(10)	2	146	48	194
1999–2000	103	(90)	11	(10)	4	118	39	157
2000–2001	108	(100)	0	(0)	0	108	36	144

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2c Unit 19B moose harvest, regulatory years 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters: Reported M	(%)	F	(%)	Unk	Total	Estimated unreported[a]	Total
1994–1995	163	(100)	0	(0)	0	163	54	217
1995–1996	136	(100)	0	(0)	0	136	45	181
1996–1997	166	(100)	0	(0)	0	166	55	221
1997–1998	158	(100)	0	(0)	1	159	52	211
1998–1999	152	(100)	0	(0)	1	153	50	203
1999–2000	108	(100)	0	(0)	4	112	37	149
2000–2001	152	(100)	0	(0)	1	153	50	203

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2d Unit 19C moose harvest, regulatory years 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters: Reported M	(%)	F	(%)	Unk	Total	Estimated unreported[a]	Total
1994–1995	152	(100)	0	(0)	0	152	50	202
1995–1996	127	(100)	0	(0)	0	127	42	169
1996–1997	153	(100)	0	(0)	0	153	50	203
1997–1998	140	(100)	0	(0)	0	140	46	186
1998–1999	149	(100)	0	(0)	0	149	49	198
1999–2000	130	(99)	1	(1)	0	131	43	174
2000–2001	121	(100)	0	(0)	1	122	40	162

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2e Unit 19D moose harvest, 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters: Reported M	(%)	F	(%)	Unk	Total	Estimated unreported[a]	Total
1994–1995	106	(100)	0	(0)	0	106	35	141
1995–1996	109	(100)	0	(0)	3	112	37	149
1996–1997	102	(100)	0	(0)	1	103	34	137
1997–1998	103	(99)	1	(1)	1	105	35	140
1998–1999	86	(100)	0	(0)	0	86	28	114
1999–2000	93	(100)	0	(0)	2	95	31	126
2000–2001	83	(100)	0	(0)	0	83	27	110

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2f Units 21A and 21E moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory year	Harvest by hunters: Reported M	(%)	F	(%)	Unk	Total	Estimated unreported[a]	Total
1986–1987	227	(95)	11	(5)	0	238	79	317
1987–1988	251	(98)	6	(2)	0	257	85	342
1988–1989	306	(98)	6	(2)	5	317	105	422
1989–1990	277	(99)	1	(1)	0	278	92	370
1990–1991	304	(99)	3	(1)	3	310	102	412
1991–1992	284	(99)	4	(1)	0	288	95	383
1992–1993	223	(99)	2	(1)	0	225	74	299
1993–1994	241	(99)	2	(1)	0	243	80	323
1994–1995	276	(97)	10	(3)	0	286	94	380
1995–1996	273	(98)	6	(2)	0	279	92	371
1996–1997	306	(95)	15	(5)	0	321	106	427
1997–1998	316	(98)	6	(2)	1	323	106	429
1998–1999	298	(97)	8	(3)	0	306	101	407
1999–2000	288	(98)	6	(2)	4	298	98	396
2000–2001	297	(99)	4	(1)	0	301	99	400

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2g Unit 21A moose harvest, 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters: Reported M	(%)	F	(%)	Unk	Total	Estimated unreported[a]	Total
1994–1995	124	(99)	1	(1)	0	125	41	166
1995–1996	116	(100)	0	(0)	0	116	38	154
1996–1997	130	(100)	0	(0)	0	130	43	173
1997–1998	113	(100)	0	(0)	0	113	37	150
1998–1999	111	(100)	0	(0)	0	111	37	148
1999–2000	123	(100)	0	(0)	1	124	41	165
2000–2001	102	(100)	0	(0)	0	102	34	136

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2h Unit 21E moose harvest, 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters: Reported M	(%)	F	(%)	Unk	Total	Estimated unreported[a]	Total
1994–1995	152	(94)	9	(6)	0	161	53	214
1995–1996	157	(96)	6	(4)	0	163	54	217
1996–1997	176	(92)	15	(8)	0	191	63	254
1997–1998	203	(97)	6	(3)	1	210	69	279
1998–1999	187	(96)	8	(4)	0	195	64	259
1999–2000	165	(96)	6	(4)	3	174	57	231
2000–2001	195	(98)	4	(2)	0	199	66	265

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 3 Permit hunt results from Lime Village Tier II (TM684) and Unit 19C (RM655) and Unit 19D (RM650), regulatory years 1992–1993 through 2000–2001

Hunt #	Regulatory year	Successful hunters	Unsuccessful hunters	Did not hunt	Total hunters
TM684	1992–1993	9	4	3	16
	1993–1994	12	2	6	20
	1994–1995	7	1	6	14
	1995–1996	5	3	7	15
	1996–1997	4	1	9	14
	1997–1998	5	2	7	14
	1998–1999	7	5	16	28
	1999–2000	2	9	17	28
RM655	1997–1998	1	0	0	1
	1998–1999	2	1	0	3
	1999–2000	0	3	1	4
	2000–2001	4	2	6	12
RM650	2000–2001	65	224	0	289

Table 4a Unit 19 moose hunter residency and success, 1986–1987 through 1999–2000

Regulatory year	Successful						Unsuccessful						Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
1986–1987	89	191	119	47	446	(54)	101	183	77	15	376	(46)	822
1987–1988	121	245	162	21	549	(54)	95	280	94	6	475	(46)	1024
1988–1989	110	285	188	54	637	(54)	132	271	105	28	536	(46)	1173
1989–1990	114	134	185	36	469	(45)	95	305	162	5	567	(55)	1036
1990–1991	81	189	111	23	404	(37)	94	329	232	20	675	(63)	1079
1991–1992	87	259	123	7	476	(47)	122	266	141	5	534	(53)	1010
1992–1993	100	256	113	41	510	(48)	123	257	149	18	547	(52)	1057
1993–1994	89	271	153	30	543	(53)	57	247	166	6	476	(47)	1019
1994–1995	121	276	181	18	596	(45)	124	368	224	16	732	(55)	1328
1995–1996	91	263	170	11	535	(44)	159	325	194	8	686	(56)	1221
1996–1997	113	295	212	12	632	(52)	123	258	202	2	585	(48)	1217
1997–1998	113	223	227	9	572	(48)	99	251	253	9	612	(52)	1184
1998–1999	93	221	210	28	552	(45)	69	312	289	11	681	(55)	1233
1999–2000	94	206	149	17	466	(41)	103	292	264	9	668	(59)	1134

Table 4b Unit 19A moose hunter residency and success, 1994–1995 through 2000–2001

Regulatory year	Successful						Unsuccessful						Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
1994–1995	56	82	23	7	168	(46)	61	107	26	2	196	(54)	364
1995–1996	28	83	23	7	141	(46)	58	89	15	1	163	(54)	304
1996–1997	42	119	20	3	184	(54)	51	86	18	0	155	(46)	339
1997–1998	44	77	19	2	142	(51)	33	67	35	3	138	(49)	280
1998–1999	56	65	19	6	146	(50)	24	89	32	1	146	(50)	292
1999–2000	45	46	21	6	118	(43)	54	76	25	4	159	(57)	277
2000–2001	18	53	32	5	108	(37)	52	70	59	3	184	(63)	292

Table 4c Unit 19B moose hunter residency and success, 1994–1995 through 2000–2001

Regulatory year	Successful						Unsuccessful						Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
1994–1995	0	71	88	4	163	(40)	0	128	108	9	245	(60)	408
1995–1996	0	66	69	1	136	(41)	0	82	107	5	194	(59)	330
1996–1997	0	54	107	5	166	(47)	0	79	103	2	184	(53)	350
1997–1998	0	41	114	4	159	(40)	0	83	147	5	235	(60)	394
1998–1999	0	48	100	5	153	(37)	0	80	175	6	261	(63)	414
1999–2000	0	44	59	9	112	(32)	0	78	159	5	242	(68)	354
2000–2001	0	60	88	5	153	(37)	0	105	160	1	266	(63)	419

Table 4d Unit 19C moose hunter residency and success, regulatory years 1994–1995 through 2000–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1994–1995	0	98	53	1	152 (52)	0	85	53	1	139 (48)	291
1995–1996	0	78	49	0	127 (49)	0	88	42	0	130 (51)	257
1996–1997	0	89	62	2	153 (60)	0	61	41	0	102 (40)	255
1997–1998	1	68	69	2	140 (58)	0	64	37	0	101 (42)	241
1998–1999	1	75	72	1	149 (52)	0	82	53	1	136 (48)	285
1999–2000	0	79	50	2	131 (50)	0	81	48	0	129 (50)	260
2000–2001	0	68	54	0	122 (50)	0	69	50	2	121 (50)	243

Table 4e Unit 19D moose hunter residency and success, regulatory years 1994–1995 through 2000–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1994–1995	57	38	6	5	106 (45)	56	49	21	5	131 (55)	237
1995–1996	53	38	19	2	112 (43)	84	44	16	2	146 (57)	258
1996–1997	56	33	14	0	103 (49)	67	22	18	0	107 (51)	210
1997–1998	54	34	17	0	105 (54)	55	23	12	1	91 (46)	196
1998–1999	28	28	15	15	86 (49)	34	45	10	3	92 (51)	178
1999–2000	45	35	15	0	95 (46)	37	52	24	0	113 (54)	208
2000–2001	48	31	3	1	83 (60)	26	26	3	0	55 (40)	138

Table 4f Units 21A and 21E moose hunter residency and success, regulatory years 1986–1987 through 2000–2001

Regulatory year	Successful						Unsuccessful						Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
1986–1987	43	135	45	15	238	(75)	10	63	7	0	80	(25)	318
1987–1988	21	164	43	29	257	(68)	9	83	20	9	121	(32)	378
1988–1989	13	177	69	58	317	(75)	2	62	28	16	108	(25)	425
1989–1990	19	178	53	28	278	(73)	9	66	18	9	102	(27)	380
1990–1991	40	203	52	15	310	(72)	13	80	25	3	121	(28)	431
1991–1992	41	200	42	4	287	(64)	22	104	34	0	160	(36)	447
1992–1993	20	152	35	19	226	(63)	8	91	26	5	130	(37)	356
1993–1994	39	141	45	14	239	(67)	9	71	36	1	117	(33)	356
1994–1995	35	184	47	17	283	(67)	8	87	43	2	140	(33)	423
1995–1996	40	191	46	2	279	(70)	10	74	31	2	117	(30)	396
1996–1997	42	206	71	2	321	(73)	8	78	31	0	117	(27)	438
1997–1998	33	212	67	11	323	(74)	7	61	41	4	113	(26)	436
1998–1999	39	194	59	14	306	(70)	3	63	62	2	130	(30)	436
1999–2000	44	152	87	15	298	(62)	16	85	82	3	186	(38)	484
2000–2001	45	162	86	8	301	(63)	10	85	78	3	176	(37)	477

Table 4g Unit 21A moose hunter residency and success, regulatory years 1994–1995 through 2000–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1994–1995	0	83	39	3	125 (52)	0	76	37	1	114 (48)	239
1995–1996	3	76	36	1	116 (64)	1	37	26	1	65 (36)	181
1996–1997	1	78	51	0	130 (65)	0	45	25	0	70 (35)	200
1997–1998	1	57	50	5	113 (63)	0	36	29	1	66 (37)	179
1998–1999	0	64	39	8	111 (58)	0	30	48	2	80 (42)	191
1999–2000	0	55	67	2	124 (53)	1	47	63	0	111 (47)	235
2000–2001	0	50	51	1	102 (47)	0	52	63	0	115 (53)	217

Table 4h Unit 21E moose hunter residency and success, regulatory years 1994–1995 through 2000–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1994–1995	40	106	8	7	161 (86)	8	17	1	0	26 (14)	187
1995–1996	34	118	10	1	163 (76)	6	40	5	1	52 (24)	215
1996–1997	31	138	20	2	191 (80)	4	37	6	0	47 (20	238
1997–1998	28	159	17	6	210 (83)	2	30	12	3	47 (17)	257
1998–1999	37	132	20	6	195 (80)	3	33	14	0	50 (20)	245
1999–2000	38	103	20	13	174 (70)	13	40	19	3	75 (30)	249
2000–2001	38	119	35	7	199 (77)	6	37	15	3	61 (23)	260

Table 5a Unit 19 moose harvest percent by transport method, regulatory years 1986–1987 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1986–1987	44	<1	44	2	3	<1	1	5	0	446
1987–1988	38	<1	44	3	7	2	<1	5	0	549
1988–1989	45	<1	43	2	5	1	<1	4	0	637
1989–1990	47	<1	41	2	2	<1	<1	5	0	469
1990–1991	53	1	35	2	4	<1	<1	4	0	404
1991–1992	49	<1	41	3	4	<1	<1	1	0	476
1992–1993	41	1	45	2	9	0	<1	2	0	510
1993–1994	57	1	33	3	2	<1	<1	3	0	543
1994–1995	47	<1	38	5	6	<1	<1	3	0	589
1995–1996	50	2	38	6	<1	<1	<1	3	0	535
1996–1997	50	2	39	5	2	<1	<1	<1	0	632
1997–1998	53	2	34	5	5	<1	<1	<1	0	572
1998–1999	50	2	35	7	5	<1	<1	<1	<1	552
1999–2000	51	1	34	8	4	<1	0	1	<1	466
2000–2001	54	1	37	6	1	0	0	<1	<1	480

Table 5b Unit 19A moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	14	0	65	<1	17	0	<1	3	0	168
1995–1996	17	0	74	<1	2	<1	0	6	0	141
1996–1997	13	0	80	<1	5	<1	0	0	0	184
1997–1998	17	0	64	2	16	0	0	<1	0	142
1998–1999	13	<1	67	1	15	0	1	1	1	146
1999–2000	21	0	59	1	14	0	0	5	<1	118
2000–2001	27	0	70	1	1	0	0	1	<1	108

Table 5c Unit 19B moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	79	0	18	0	<1	0	0	2	0	163
1995–1996	85	1	11	2	0	0	1	0	0	136
1996–1997	90	0	8	1	0	0	0	1	0	166
1997–1998	92	0	5	0	1	0	2	0	0	159
1998–1999	90	0	7	1	0	0	1	1	<1	153
1999–2000	88	0	8	3	0	0	0	1	0	112
2000–2001	87	0	12	0	0	0	0	1	0	153

Table 5d Unit 19C moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	74	3	5	15	0	2	0	1	0	152
1995–1996	75	4	3	15	0	<1	2	<1	0	127
1996–1997	76	7	0	16	0	<1	0	<1	0	153
1997–1998	73	8	2	15	<1	1	0	0	0	140
1998–1999	64	6	1	25	2	1	0	1	0	149
1999–2000	70	4	0	24	0	1	0	1	0	131
2000–2001	71	3	1	21	4	0	0	0	0	122

Table 5e Unit 19D moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	9	0	74	4	6	0	3	4	0	106
1995–1996	19	2	67	6	<1	0	2	4	0	112
1996–1997	17	0	71	3	4	1	4	0	0	103
1997–1998	19	0	74	2	1	0	2	2	0	105
1998–1999	20	0	79	0	1	0	0	0	0	86
1999–2000	20	0	78	2	0	0	0	0	0	95
2000–2001	5	0	92	2	0	0	0	1	0	83

Table 5f Units 21A and 21E moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	27	<1	61	1	6	2	0	2	0	286
1995–1996	32	<1	62	<1	3	0	<1	1	0	279
1996–1997	33	0	59	<1	6	<1	0	<1	0	321
1997–1998	29	0	66	<1	3	0	0	<1	0	323
1998–1999	34	0	61	<1	3	0	0	<1	0	306
1999–2000	34	<1	60	<1	4	<1	<1	2	0	298
2000–2001	30	0	65	<1	3	0	<1	2	0	301

Table 5g Unit 21A moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	57	<1	33	2	<1	5	0	2	0	125
1995–1996	66	0	29	2	0	0	<1	2	0	116
1996–1997	68	0	30	2	0	0	0	<1	0	130
1997–1998	70	0	28	<1	<1	0	0	<1	0	113
1998–1999	69	0	30	0	<1	0	0	0	0	112
1999–2000	70	1	24	1	0	1	1	2	0	124
2000–2001	69	0	27	1	0	0	1	2	0	102

Table 5h Unit 21E moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	4	0	83	<1	10	0	0	2	0	161
1995–1996	8	<1	86	0	4	0	0	1	0	163
1996–1997	10	0	79	<1	9	<1	0	<1	0	191
1997–1998	8	0	87	0	4	0	0	<1	0	210
1998–1999	14	0	79	<1	5	0	0	2	0	195
1999–2000	7	0	85	0	6	0	0	2	0	174
2000–2001	10	0	84	0	4	0	0	2	0	199

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 21B (4871 mi^2)

GEOGRAPHIC DESCRIPTION: Lower Nowitna River, Yukon River between Melozitna and Tozitna Rivers

BACKGROUND

In this portion of Interior Alaska, even the earliest accounts of the area mentioned the presence of moose. Moose had apparently become abundant by the time gold seekers converged on the area in the early 1900s. The village of Ruby had a population of 10,000 people during the 1910 Gold Rush, and many moose were hunted to supply the townsfolk and miners with meat. The area supported a large moose population from the early 1900s to late 1970s. Several severe winters in the late 1960s and early 1970s initiated widespread declines in moose populations throughout the Interior, including Unit 21B.

Historically, wildfires were a major force affecting the productivity and diversity of moose habitat in this area. Large fires burned a major portion of the area before the 1950s; effective fire suppression substantially altered this fire regime. The 1982 Tanana–Minchumina Fire Plan has allowed some fires to burn with minimal interference.

The Nowitna River to the east of Ruby is a popular hunting area for residents of Ruby, Tanana, and, to a lesser extent, Galena. It is also a popular hunting area for Fairbanks residents who use boats and aircraft for access. Because of its long history of use by both local and nonlocal hunters, this area was the focus of much of the management effort in Unit 21B over the years.

Aerial moose surveys during 1977–1979 indicated moose numbers were declining in the Nowitna. Wolves were abundant compared to the number of moose available, and predation by wolves was believed responsible for the decline in moose numbers.

A moose population estimation survey in 1980, using methods described by Gasaway et al. (1986), estimated 2386 ± 429 moose in a 2774-mi^2 portion of the subunit in the lower Nowitna drainage. A 1986 population estimation survey conducted in a 1556-mi^2 portion of the 1980 survey area indicated a further reduction in moose numbers. A 1990 population estimation survey in the same area surveyed in 1980 indicated a decline that was significant at the 80%

probability level, but not at the 90% level. Results of a 1995 population estimation survey in a 1338-mi^2 portion of the subunit were not significantly different (90% confidence) from those of the 1990 survey.

In addition to the lower portion of the Nowitna drainage, Unit 21B includes the area east of the Ruby–Poorman Road, the banks of the Yukon River from Ruby to Tanana, the Blind River, and the Boney River. These areas produce 36–46% of the reported Unit 21B harvest.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

- Manage Unit 21B moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and that minimizes disruption of local residents' lifestyles.

MANAGEMENT OBJECTIVES AND RELATED ACTIVITY

- Maintain a moose population of 3000–4000.

  Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

- Provide for harvest not to exceed 150 moose or 5% of the annual moose population estimate.

- In combination with Unit 21C, implement at least 2 habitat enhancement activities every 5 years.

METHODS

Established trend count areas were surveyed cooperatively with US Fish and Wildlife Service to assess population status and trend. Piper PA-18 (or equivalent) aircraft were used, and contiguous survey units of approximately 12 mi^2 each were searched at a rate of at least 4 min/mi^2 to ensure reasonably high sightability, minimal bias, and data comparability between years. A moose population estimation survey was conducted in November 1995 using a regression survey method developed by ADF&G biometricians that uses a probability sample and regression estimator (Särndal et al. 1992).

Moose population estimation surveys conducted over 4754 mi^2 of Unit 21B in 2001 utilized Geostatistical Spatial Population Estimator (GSPE) techniques (Ver Hoef 2001). Survey techniques were modified from those outlined by Gasaway et al. (1986). An important change from the Gasaway methodology was, instead of geographical land characteristics, a grid system based on latitude and longitude coordinates was used to locate sample units (~5.7 mi^2 in size), with search intensity of ~6 min/mi^2.

We monitored harvest by checking moose harvest reports and operating a moose hunter checkstation on the Nowitna River.

Survey and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY01 = 1 Jul 2001–30 Jun 2002).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Using the results of the 1995 population estimation survey and one conducted in 1990, Woolington (1998) estimated there were 2324–3530 moose in the subunit. A density of 0.20 moose/mi^2 was applied to the portion of the Little Mud River drainage not included in the population estimation survey, and a density of 0.64 moose/mi^2 was applied to the remainder of the subunit that was not surveyed. Higher moose densities exist in favorable habitat along the Nowitna floodplain and immediately adjacent to the Yukon River. Densities are low to moderate away from the river.

Results from the population surveys conducted in November 2001, estimated a total of 3160 moose (1828–4493; 90% CI) over 4754 mi^2 of Unit 21B (Table 1). This was close to the estimate reported for RY97-RY98. For the entire survey area the GSPE analysis resulted in the following: the calf:cow ratio was 18.3:100 (7.9–28.8:100; 90% CI), the yearling bull:cow ratio was 9.0:100 (2.5–15.6:100; 90% CI), and the adult bull:cow ratio was 38.2:100 (12.5–63.8:100; 90% CI).

Survey data collected in early winter from established trend count areas (TCA) along the lower Nowitna suggested stable or slightly increasing moose densities during 1991–1998 (Tables 2 and 3). However, surveys conducted from 1999 to 2001 indicated the trajectory of the population may be changing. For example, recruitment indicators such as the number of calves per 100 cows have begun to decline; however, because of inadequate snow coverage, the 1999 results were not reliable.

In combination with the GSPE results, the TCA data indicate that the population declined during RY99–RY00. The TCA results indicated the number of cows in the population declined by as much as 23% from 2000 to 2001. Because of the decline in the number of cows, most of the ratio indicators estimated by the GSPE and TCAs were maintained at a higher level than would be expected for a declining population.

Population Composition

Composition data were available from aerial surveys we conducted with FWS staff in established TCAs on the Nowitna National Wildlife Refuge (Tables 2 and 3). Fall 2001 survey results indicated bull:cow ratios along the river decreased from the previous year while calf:cow ratios increased. Yearling bull:100 cow ratios were relatively unchanged empirically, but the decline in the denominator value of the ratio (cows) suggests overwinter survival was poor. The occurrence of twin calves among moose observed in these early winter surveys has been very poor since the trend areas were established in 1992, particularly at the Nowitna Mouth TCA.

The 2001 population estimation data indicated the sex and age composition over the entire area was not as depressed as the area along the river. The bull:cow ratio was 38:100, the yearling bull:cow was 9:100, and the calf:cow ratio was 18:100.

Distribution and Movements

Based on movements of radiocollared cow–calf pairs, most cows spend their summer months around open grass and brush meadows on the floodplain, but away from the river (Woolington 1998). In October they move to the riparian areas, where they remain until early May. Relatively few cow moose wintered in the hills to the north and south of the Nowitna River.

MORTALITY

Harvest

Season and Bag Limit.

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 21B that portion within the Nowitna River drainage:		
RESIDENT HUNTERS: 1 bull.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–20 Sep
Remainder of Unit 21B:		
RESIDENT HUNTERS: 1 bull	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. Subsistence and general registration hunts were established for the Nowitna River drainage in Unit 21B by the Alaska Board of Game in March 1996. This action was to counter the possibility of the Federal Subsistence Board closing federally managed lands in the Nowitna River drainage to nonlocal hunters because of perceived declines in moose. Two separate registration hunts were established. The subsistence registration hunt was opened to all Alaska residents, with a season of 5–25 September and a bag limit of 1 bull. All the meat had to remain on the bones, the head had to be salvaged, and the antlers were to be cut to destroy the trophy value. The general registration hunt was opened to all hunters, with a season of 5–20 September and a bag limit of 1 bull moose with spike fork antlers or antlers at least 50 inches wide, or 4 brow tines on at least 1 side for residents. For nonresidents the bag limit was 1 bull with antlers at least 50 inches wide or 4 brow tines on at least 1 side.

Registration hunts were discontinued in RY98. Seasons and bag limits for the remainder of the subunit remained unchanged. In 2002 the board adopted a regulation for all of Unit 21B requiring hunters to leave the meat on the bone of the four quarters and the ribs until the meat is transported from the field.

Harvest. Reported harvest for the subunit was fairly stable and averaged 57 (range = 47–69) moose annually during RY97–RY01 (Table 4). The Unit 21B unreported harvest was estimated at 5 moose per year for Ruby residents, and 15 moose per year for Tanana residents. The Nowitna drainage produced 65–90% ($\bar{x}$ = 77%) of the subunit's reported harvest during RY97–RY01 (Tables 5 and 6).

The estimated RY99 harvest by residents of Unit 21B was about 47 moose (Anderson et al. 2001). The estimated unreported harvest (Table 4) incorporates the RY99 Division of Subsistence estimated moose harvest data for Ruby and Tanana (approximately 36 moose annually; 3 year $\bar{x}$), less the reported harvest by those same villages (approximately 15 moose annually). Because subsistence harvest remained relatively constant, the difference of approximately 20 unreported moose between the RY99 subsistence data and the local reported harvest was extrapolated for RY99–RY01.

Checkstation Results. Since RY88 a moose hunter checkstation has been located at the mouth of the Nowitna. During RY96–RY97 the checkstation was mandatory because it was the only place Nowitna River registration hunt permits were available. Except for RY97, hunter numbers and success rate of hunters passing through the Nowitna checkstation was relatively constant (Table 5). It is unclear why there was a brief decline in the number of hunters in RY97.

Hunter Residency and Success. Based on harvest reports, the majority of Unit 21B hunters were Alaska residents who resided outside the subunit, particularly Fairbanks (Table 6). Average success rate during RY97–RY01 was 43.6% (range = 35–60%). This was expected because a majority of the harvest in Unit 21B occurred along the river.

Harvest Chronology. During RY99–RY00, hunter reports indicated that most moose were shot in the last half of the September season (Table 7). This was probably due to relatively little movement of bulls in the earlier part of the season compared to the later part of the season.

Harvest was not reported for the winter months, but it was probably close to 20% of the annual kill. Winter harvest likely occurred during October–March (Anderson et al. 2001).

Transportation Methods. Not surprisingly, the majority of hunters used boats to hunt moose (Table 8). It is undetermined why a relatively large proportion of transportation methods were unknown in RY98 (33%), but I do not believe any significant changes in the mode of transportation occurred. Snowmachines were used during the winter, but winter reporting rates were low and therefore snowmachine use was underrepresented.

Other Mortality

Predation mortality on moose calves is significant in the subunit (Osborne et al. 1991). During calf mortality studies of radiocollared newborn moose, black bears were the main predator, killing 38% of all calves. Wolves killed 11% of all calves, unidentified predators killed 8%,

grizzly bears killed 2%, and 5% died from other natural causes. A single pack of 25 wolves was observed during the fall 1999 moose trend count survey at the mouth of the Nowitna. Wolf surveys conducted in neighboring Units 21D and 24 during RY99 and RY00, demonstrated an increase in wolves (ADF&G files, Galena, 30 May 2000). Local residents have reported similar observations regarding wolf numbers in Unit 21B.

HABITAT

Assessment

No new data were collected on habitat conditions during this reporting period. Observations indicated browse availability was not limiting the moose population. Regeneration from a fire that burned in 1986 east of the Nowitna River in the Little Mud River drainage provided excellent moose browse. During November 1995 surveys, this area was classified as high moose density. Several adjacent sample units were classed as medium. There is a dense stand of black spruce between the 1986 burn and the Nowitna River that should be considered for a prescription burn.

CONCLUSIONS AND RECOMMENDATIONS

Density data from 1991–2001 fall surveys of permanent trend count areas was greatly variable from year to year and did not provide a clear picture of what the population trend may be. However, classification data showed the number of calves declined in 2000 and 2001. Although yearling bull:100 cow ratios appeared to be stable, data from the last 2 years was heavily influenced by the low number of cows counted. Bull:cow ratios were low for the last several years in both TCAs along the heavily hunted portion of the Nowitna River. Away from the river the bull:cow ratio was slightly higher.

Population estimation surveys conducted in 2001 supported the trend area conclusions. In the western half of the unit where the peak estimate was calculated in 1990, moose numbers declined in 1995 and again in 2001. The current estimate for the entire unit of 3160 (1828–4494; 90% CI) is within the range of the management objective, albeit the lower end. The goal for RY99–RY00 was met. The moose population continued to support the consumptive demands as well as the nonconsumptive uses identified.

We met the harvest objective not to exceed 150 moose or 5% of the annual moose population estimate. Harvest that was monitored through the harvest reporting system and at checkstations demonstrated a harvest rate of less than 3% of the total Unit 21B estimated population for RY99–RY00.

The objective to implement habitat enhancement projects was limited to review of fire management plans and fire suppression policies. I recommend a prescribed burn in the upland area east of the Nowitna floodplain and north of the Little Mud River to Bering Creek. This area is adjacent to several old burns that are reaching peak browse production. The area west of the Nowitna in the upper Big Creek drainage is also dominated by late seral spruce and birch and should be allowed to burn to enhance potential moose habitat.

Maintaining a moose population of 3000–4000 will be changed from an objective to a monitoring activity for the next reporting period. We will continue to monitor the population, conduct trend count surveys annually and population estimation surveys when funding is available. We will also notify relevant wildlife agencies, boards, and advisory committees if the moose population declines below 3000–4000 moose. However, it does not appear feasible at this time to maintain the moose population at this level if predator control is necessary to do so.

Predators remain abundant and continue to be the primary factor limiting moose abundance in the area. Harvest of wolves within the subunit is very low and few black bears are harvested. The moose calf mortality study indicated black bears were the major predator of moose calves (Osborne et al. 1991). Efforts should be made to increase the harvest of predators if more moose are desired.

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Table 1 Unit 21B Lower Nowitna River moose population estimate, October–November 2001

Unit	Area mi^2	Population	90% CI[a]	Bulls:100 Cows	Calves:100 Cows	Yrlg Bulls:100 Cows	Density
West	1531	759	19.6	25.8	19.4	7.2	0.50
Total	4754	3161	42.2	38.2	18.3	9.0	0.67

[a] Confidence interval (% ±).

Table 2 Unit 21B Nowitna/Sulatna confluence (75.5 mi^2) aerial moose composition counts, regulatory years 1991–1992 through 2001–2002[a]

Regulatory year	Bulls:100 cows	Yrlg bulls: 100 cows	Calves:100 cows	Twins:100 cows	Percent calves	Moose	Moose/mi^2
1991–1992	21	9	29	8	20	200	2.7
1992–1993	18	1	48	7	29	171	2.3
1993–1994	22	7	20	0	14	195	2.6
1994–1995	16	6	20	4	15	191	2.5
1995–1996	15	4	33	6	22	148	2.0
1996–1997	18	8	23	6	13	216	2.9
1998–1999	19	2	28	6	19	180	2.5
1999–2000[b]	6	1	23	12	18	106	1.5
2000–2001	30	6	7	0	5	185	2.5
2001–2002	19	9	13	0	10	137	1.8

[a] US Fish and Wildlife Service.

[b] Poor snow conditions during survey

Table 3 Unit 21B Nowitna mouth (59 mi^2) aerial moose composition counts, regulatory years 1992–1993 through 2001–2002[a]

Regulatory year	Bulls:100 cows	Yrlg bulls:100 cows	Calves:100 cows	Twins:100 cows	Percent calves	Moose	Moose/mi^2
1992–1993	21	0	31	0	20	138	2.9
1993–1994	32	6	32	6	20	189	3.2
1994–1995	19	8	23	0	22	148	2.5
1995–1996	16	5	26	0	18	116	2.0
1996–1997	21	7	22	0	16	185	3.1
1998–1999	20	3	12	0	9	182	3.0
1999–2000[b]	11	8	21	0	16	87	1.4
2000–2001	22	4	8	0	7	170	2.9
2001–2002	13	6	28	2	20	154	2.6

[a] US Fish and Wildlife Service.

[b] Poor snow conditions during survey

Table 4 Unit 21B moose harvest, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest by hunters				Unreported	Total
	Bull	Cow	Unk	Total		
1990–1991	81	0	0	81	15	96
1991–1992	65	0	0	65	15	80
1992–1993	46	0	0	46	15	61
1993–1994	71	1	0	72	15	87
1994–1995	63	0	0	63	15	78
1995–1996	66	0	0	66	15	81
1996–1997	63	0	0	63	15	78
1997–1998	58	1	0	59	15	74
1998–1999	53	2	2	57	15	72
1999–2000	69	0	0	69	20	89
2000–2001	49	1	2	52	20	72
2001–2002[a]	47	0	0	47	20	67

[a] Preliminary results.

Table 5 Unit 21B Nowitna River checkstation hunters (R), harvest (H) and success (S%), regulatory years 1990–1991 through 2001–2002[a]

Regulatory	Local villages[a]			Fairbanks			Other residents			Nonresident			Total		
year	R	H	S%	R	H	S%	R	H	S%	R	H	S%	R	H	S%
1990–1991	23	7	30	67	32	48	26	12	46	14	4	29	130	55	42
1991–1992	21	9	43	72	24	33	44	11	25	17	2	12	154	46	30
1992–1993	24	3	12	38	19	50	53	10	19	10	2	20	125	34	27
1993–1994	19	7	37	58	26	45	35	19	54	20	1	5	133	53	40
1994–1995	16	6	37	63	27	43	41	16	39	13	5	38	134	54	40
1995–1996	16	3	19	63	24	38	44	9	20	9	2	22	132	38	29
1996–1997	19	2	11	54	21	39	36	12	33	20	2	10	129	37	29
1997–1998	16	1	6	57	29	51	21	8	38	7	3	43	101	41	41
1998–1999	17	4	24	57	26	46	27	17	63	22	3	14	123	50	41
1999–2000	24	3	13	57	21	37	60	17	28	14	4	29	155	45	29
2000–2001	11	2	18	59	21	36	56	18	32	28	6	21	154	47	31
2001–2002[a]	27	0	0	62	21	34	48	8	17	23	5	22	160	34	21

[a] US Fish and Wildlife Service.

[b] Tanana, Ruby, and Galena.

Table 6 Unit 21B moose hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total	Local resident[a]	Nonlocal Resident	Nonresident	Unk	Total	
1990–1991	22	48	8	3	81	10	41	1	1	53	134
1991–1992	21	34	8	2	65	21	56	8	1	86	151
1992–1993	12	31	2	1	46	24	55	10	1	90	136
1993–1994	23	45	3	1	72	7	47	11	0	65	137
1994–1995	12	44	5	2	63	7	44	2	0	53	116
1995–1996	15	43	8	0	66	11	60	6	0	77	143
1996–1997	16	44	3	0	63	38	68	17	0	123	186
1997–1998	9	46	4	0	59	27	73	8	0	108	167
1998–1999	7	46	3	1	57	10	24	4	0	38	95
1999–2000	13	49	6	1	69	10	66	11	3	90	159
2000–2001	9	30	12	1	52	3	48	17	0	68	120
2001–2002[b]	11	27	8	1	47	11	53	15	0	79	126

[a] Tanana, Ruby, and Galena.
[b] Preliminary results.

Table 7 Unit 21B moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2001–2002

Regulatory year	Harvest chronology percent by month/day		
	9/1–9/14	9/15–9/25	*n*
1996–1997	42	58	59
1997–1998	31	69	55
1998–1999	39	61	49
1999–2000	37	63	68
2000–2001	37	63	49
2001–2002[a]	17	83	46

[a] Preliminary results.

Table 8 Unit 21B moose harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	*n*
1990–1991	11	1	78	0	0	2	6	1	81
1991–1992	9	1	75	0	0	0	10	4	65
1992–1993	10	0	76	1	0	0	8	4	46
1993–1994	9	0	82	3	1	0	3	1	72
1994–1995	21	0	69	2	0	0	6	3	63
1995–1996	12	0	79	3	0	0	4	1	66
1996–1997	4	0	92	2	0	0	0	2	63
1997–1998	5	0	88	0	0	0	5	5	59
1998–1999	4	0	60	0	0	0	4	33	57
1999–2000	7	1	78	0	0	1	9	3	69
2000–2001	31	0	67	0	0	0	0	0	52
2001–2002[a]	15	0	70	0	2	0	13	0	47

[a] Preliminary results.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 21C (3671 mi^2)

GEOGRAPHIC DESCRIPTION: Dulbi River above Cottonwood Creek and Melozitna River above Grayling Creek

BACKGROUND

Moose have been present in Unit 21C throughout the recent history of Interior Alaska (S Huntington, personal communication). Moose densities are low due to limited habitat and predation by bears and wolves, and population trends are unknown. Access into the subunit is limited and is mostly by aircraft. Thus, hunter numbers and harvest has been low and probably does not adversely impact the moose population. Because of low harvest, there has been little need to extensively monitor the moose population in this area.

Terrain in the subunit is hilly and mountainous, with peaks as high as 5000 feet. Corridors along 2 large rivers, the Melozitna and the Dulbi, represent the main summer habitat. Numerous fires have resulted in large expanses of potentially good winter habitat.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.

- Provide a sustained opportunity to participate in hunting moose.

MANAGEMENT OBJECTIVE

- Maintain a harvest of bulls that is ≤6% of the estimated population.

METHODS

POPULATION STATUS AND TREND

We conducted a moose stratification survey on 18 and 19 April 2000 using the Geostatistical Population Estimator (GSPE), a modification of the "Gasaway" technique (Gasaway et al. 1986)

using spatial statistics (Ver Hoef 2001). The stratification provided the basis for a rough population estimate of the subunit, and will be used to conduct population estimation surveys in the future. It was conducted in a Cessna 206 flown at 95–120 mph at altitudes of 500–1000 ft above ground, with 2 observers in the back seat and 1 observer/recorder in the front seat. Prior to the flight, we divided Unit 21C into a grid of 658 sample units (3671 mi^2) that were approximately 5.5 mi^2. We flew on the north–south boundary between 2 sample units, and each sample unit was classified as low or high moose density, based on number of moose observed, number of tracks observed, and habitat. If moose were spotted in the sample unit during the flight, it was designated a high moose density unit. Alternatively, if there were no moose observed it was typically designated a low moose density unless it was judged to be good habitat and >5 sets of tracks were observed. We surveyed 438 sample units (1971 mi^2). The area not surveyed was primarily high mountainous terrain in the Kokrine Hills. It will be stratified based on known habitat type and type of habitat estimated from a topographic map. Sex and age of moose were not recorded. No other surveys were completed in Unit 21C.

HARVEST

We monitored harvest and hunting pressure using harvest reports submitted by hunters. Total harvest, residency and success, chronology, and transportation were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000–30 Jun 2001).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

No surveys were completed in Unit 21C this reporting period. Survey conditions for the April 2000 stratification were only fair because hilly and mountainous terrain and bright light adversely affected sightability of moose. However, conditions were not poor because the bright light was an advantage for locating fresh tracks, which are a stratification criteria. Because moose distribution may be dependent on seasonal influences, this stratification will apply best to a spring survey.

We identified 39 sample units as high density and 399 as low density from a total of 438 sample units. Moose were concentrated on the north side of the Melozitna River on the hills that divide the drainages of the Melozitna and Dulbi Rivers. Additional moose and tracks were observed on the western end of the subunit within the Dulbi River drainage as we approached the Koyukuk River. However, only 31 moose were observed during the survey. This was lower than expected for the area and was probably partially a result of low sightability.

Estimated moose density was 0.35–0.45/mi^2 (1284–1651 moose) using the results of this survey and by comparing similar habitat to known densities elsewhere in the state where bears and wolves are lightly harvested (Gasaway et al. 1992). This density is lower than previously estimated (0.5–1.0 moose/mi^2; Osborne 1996).

MORTALITY

Harvest

Season and Bag Limit.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
RY90–RY99		
Unit 21C RESIDENT AND NONRESIDENT HUNTERS: 1 bull.	5 Sep–25 Sep	5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. Seasons and bag limits remained the same during the past 12 years (RY90–RY01). During the March 2000 Board of Game meeting, harvest of 600–800 moose was established as the amount reasonably necessary for subsistence uses in Unit 21. During the March 2002 Board of Game meeting, (after this report period) a regulation was adopted that will require hunters to keep the meat on the bone of the 4 quarters and ribs, until they remove the harvested moose from the field.

Hunter Harvest. Harvest was relatively stable with a mean kill of 24 ± 7.7 ($\bar{x}$ ± 1*s*) moose annually for the past 12 years (RY90–RY01; Table 1). Two seasons that fluctuated dramatically from the mean were RY92, when only 9 moose were harvested, and RY97, when 41 moose were harvested. The high harvest in RY97 may have been caused by an additional big game guiding operation in the Melozitna drainage. In RY00 and RY01, 25 and 28 moose were harvested, respectively. Number of hunters was also stable during the past 10 years with a mean of 41 ± 7.7 ($\bar{x}$ ± 1*s*) and a range of 31–54.

Annual harvest during RY99–RY00 was <5% of the estimated number of moose in the subunit. If harvest was excessive, the proportion of large bulls in the harvest would be expected to decline. Instead, the proportion of large bulls (≥50") has remained high (*r* = 61–85%) during the past 7 years (RY95–RY01).

Hunter Residency and Success. During the report period, no one lived within the subunit; however, residents from Ruby in adjacent Unit 21B occasionally hunted the Melozitna River. Nonresidents comprised an average of 38% ± 16% ($\bar{x}$ ± 1*s*) of the hunters during RY90–RY01. Although nonresident hunters increased to 45% in RY99–RY01, the total number of hunters increased little (Table 1). Percent success was >50% for RY90–RY01, except in RY92 when success was 29%. High success rates were probably due to relatively low hunter numbers and concentrations of moose along the river corridors in September.

Harvest Chronology. Moose were harvested throughout the season, but the highest percent of harvest occurred during mid-September (Table 2).

Transport Methods. Hunters mainly used aircraft for transport (Table 3). A waterfall near the mouth of the Melozitna River restricts travel up the river and extensive sandbars impede boat access into the upper Dulbi River.

Other Mortality

Wolves and grizzly and black bears live throughout the subunit. In 1995, Osborne (1996) estimated a minimum of 60 wolves in the subunit and a grizzly bear density of 1/40 mi^2. Numbers of wolves and black bears have increased in adjacent Units 21D and 24 and have probably increased in Unit 21C. Predation presumably influenced population status in the past and may be increasing. Wolf and bear harvests were low (<10 annually) because hunter access is limited.

CONCLUSIONS AND RECOMMENDATIONS

Moose density in Unit 21C was low (0.35–0.45 moose/mi^2) with an estimated 1284–1651 moose present in the subunit. Human use of the moose population was low and recent harvest could be sustained even if the population experienced a substantial reduction.

For example, if harvests were not sustainable, the proportion of large bulls in the harvest would be expected to decline. Instead, large bulls (≥50" antler spreads) comprised most of the harvest (62–85%) during RY97–RY01. We achieved our first management goal to protect, maintain, and enhance the moose population and its habitat by monitoring moose harvest pressure, by maintaining open seasons for bear and wolf hunting and trapping, and by encouraging the Department of Natural Resources/Division of Forestry to let wildfires burn. We achieved our second goal to provide a sustained opportunity to participate in hunting moose by maintaining long hunting seasons. In addition, we achieved the management objective to maintain a harvest of bulls that is ≤6% of the estimated population. We estimated the harvest rate to be less than 2% annually. Although harvest has remained low, we recommend obtaining a population estimate and/or a bull:cow ratio to monitor effects of harvest on the population.

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Table 1 Unit 21C moose hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total	
1990–1991	1	18	5	1	25 (67)	0	9	3	0	12	37
1991–1992	0	15	5	0	20 (50)	0	17	3	0	20	40
1992–1993	0	7	2	0	9 (29)	0	15	7	0	22	31
1993–1994	0	11	9	0	20 (51)	0	13	6	0	19	39
1994–1995	0	17	10	0	27 (57)	4	14	2	0	20	47
1995–1996	0	12	13	0	25 (61)	0	13	3	0	16	41
1996–1997	0	10	5	0	15 (56)	0	9	3	0	12	27
1997–1998	1	14	26	0	41 (76)	0	10	3	0	13	54
1998–1999	1	8	12	0	21 (58)	0	9	6	0	15	36
1999–2000	0	15	16	0	31 (63)	0	13	5	0	18	49
2000–2001	0	9	16	0	25 (61)	0	11	5	0	16	41
2001–2002[b]	0	13	15	0	28 (55)	0	16	7	0	23	51

[a] Local resident resides in Units 21C or 21B.
[b] Preliminary data.

Table 2 Unit 21C moose harvest chronology percent by month/day, regulatory years 1995–1996 through 2001–2002

Regulatory year	Harvest chronology percent by month/day				
	9/5–9/10	9/11–9/15	9/16–9/20	9/21–9/25	*n*
1995–1996	29	33	25	12	24
1996–1997	7	33	40	20	15
1997–1998	12	36	34	17	41
1998–1999	25	35	30	10	20
1999–2000	20	30	27	23	30
2000–2001	21	25	50	4	24
2001–2002[a]	16	20	32	32	25

[a] Preliminary data.

Table 3 Unit 21C moose harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest percent by transport method							
	Airplane	Horse	Boat[a]	3- or 4-wheeler	Snowmachine	ORV	Unknown	*n*
1990–1991	90	0	10	0	0	0	0	21
1991–1992	83	0	4	0	0	0	13	23
1992–1993	89	0	11	0	0	0	0	9
1993–1994	70	10	20	0	0	0	0	20
1994–1995	89	0	11	0	0	0	0	27
1995–1996	84	0	4	0	0	0	12	25
1996–1997	93	7	0	0	0	0	0	15
1997–1998	85	0	10	0	0	0	5	41
1998–1999	90	0	10	0	0	0	0	21
1999–2000	74	0	23	3	0	0	0	31
2000–2001	60	0	40	0	0	0	0	25
2001–2002[b]	61	0	36	0	0	4	0	28

[a] Includes airboats.
[b] Preliminary data.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 21D (12,113 mi^2)

GEOGRAPHIC DESCRIPTION: Yukon River from Blackburn to Ruby and Koyukuk River drainage below Dulbi Slough

BACKGROUND

Moose are abundant in much of Unit 21D. However, high densities are a relatively new occurrence. Local residents first reported seeing occasional moose tracks during winters in the 1930s. During the 1940s and early 1950s, numbers of moose and wolves slowly increased (Huntington 1993). During the 1950s, federal wolf control and aerial shooting reduced the wolf population, allowing a rapid expansion of the moose population during the late 1950s and on through the 1960s. Expansion may have begun slowing in 1959 when statehood brought an end to federal wolf control. The moose population reached peak numbers about 1970 (S Huntington, personal communication to T Osborne, ADF&G) and then stabilized or declined slightly in localized areas in response to increased predation and hunting pressure. Increased predation may have been related to passage of the Federal Airborne Hunting Act in 1972, which halted aerial shooting of predators.

Moose trend count areas (TCA) established in 1981 in the Three Day Slough and Yukon floodplain areas indicated generally increasing moose densities through about 1993 (Tables 1–8). Initially, we thought this increase was due to better surveys, but a population estimation survey of the Kaiyuh Flats and the lower Koyukuk River in 1987 supported data from the TCAs (Osborne 1996). Moose densities were high along the Yukon River floodplain (3–6 moose/mi^2) and were very high on the Koyukuk River in the Three Day Slough TCA, where densities reached 13.3 moose/mi^2 in early winter 1993. We estimated that 6340 moose inhabited the survey area, and extrapolation of the data suggested a unitwide population of 9000–10,000 in 1993.

Results from a second survey in fall 1997 in the lower Koyukuk drainage and the Kaiyuh Flats indicated moose numbers were similar to the 1993 estimate (Huntington 1998). However, declining recruitment parameters from the TCAs since 1997 and a population estimation survey conducted in 2001, indicated the population was closer to 8500–9500 moose by winter 2001–2002.

There are 4 villages within the subunit (Kaltag, Nulato, Koyukuk, and Galena) and the residents of each village have traditional hunting areas. However, Galena residents tend to travel farther afield in the direction of the Koyukuk River. Nonresidents and Alaskans residing outside Unit 21D, primarily hunt the Koyukuk River between the Kateel River and the Dulbi Slough. Hunting pressure appears to be gradually shifting further upriver as hunters from outside the unit learn to deal with the logistics of accessing the area. In 1979 the Koyukuk Controlled Use Area (KCUA) was established in an attempt to reduce participation of nonlocal hunters by prohibiting the use of aircraft. However, by 1986 the hunters arriving by boat from outside the unit equaled the number of hunters who previously accessed the area by aircraft.

Reported harvest prior to 1981 was largely inaccurate because many local residents either did not obtain licenses or failed to report. In 1981 a program was initiated that made it easier for residents of the area to obtain hunting licenses and harvest reports. Educational and enforcement efforts improved the reporting rate by local residents, but at least 25% of the harvest is still unreported.

A hunter checkstation has been operating on the Koyukuk River since 1983. In 1990 the Ella's Cabin checkstation on the Koyukuk River became a mandatory stop for all hunters. The checkstation enables accurate determination of the number of hunters using the river to access the KCUA within Unit 21D. It is also used to educate local residents concerning licensing and reporting requirements, and to inform nonlocal hunters about regulations specific to the area and about the locations of private property near the river.

The fall hunting season dates changed several times between 1975 and 1981. From 1981 through 1996 there was a 21-day fall season for the entire subunit. Harvest of cows was allowed during the last 5 days. A 10-day season in early March also provided hunting opportunity for Alaska residents. In 1991, nonresidents were restricted to bulls with an antler spread of ≥50-inches, or at least 3 brow tines on 1 side. In 1992 the minimum number of brow tines on 1 side was increased to 4. Also beginning in 1992, meat of the hindquarters, forequarters, and ribs of any moose taken in the KCUA had to remain on the bone. In 1996, due to increasing moose hunter numbers and moose harvest, subsistence and general registration hunts were established for the KCUA, downstream from Huslia. In 2000, 2 resident and 2 nonresident drawing hunts replaced the general registration hunt and the subsistence registration hunt was shifted to open 5 days earlier.

MANAGEMENT DIRECTION

MANAGEMENT GOALS AND OBJECTIVES

Koyukuk River Drainage

Management goals and objectives were formulated during the previous reporting period, as part of the planning process.

GOAL 1: Manage Koyukuk River drainage moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

Objective 1: Maintain a moose population of 9000–10,000.

Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

Objective 2: Provide for a harvest of moose, not to exceed 700 moose or 7% of the annual moose population estimate each regulatory year.

Activity 1: Monitor hunter use levels in the Koyukuk River drainage.

Activity 2: Monitor impacts (social and environmental) to private property and local residents by Koyukuk River moose hunters.

Activity 3: Develop programs to improve population and harvest data for moose in Unit 21D.

Objective 3: Provide for moose hunting opportunity, not to exceed 950 hunters per regulatory year.

GOAL 2: Protect and enhance moose habitat.

Objective 1: In combination with Unit 24, implement at least 2 habitat enhancement activities every 5 years.

GOAL 3: Reduce meat spoilage by hunters.

Objective 1: Reduce the amount of spoiled meat observed at Ella's Cabin and at hunting camps by 10% each regulatory year.

Activity 1: Implement a program at Ella's Cabin checkstation to monitor percentage of meat lost due to spoilage.

GOAL 4: Maintain opportunities for wildlife viewing, photography and other nonconsumptive uses of wildlife within the Koyukuk River drainage.

Objective 1: Increase the number of people engaging in nonconsumptive uses of wildlife by >1% each regulatory year.

Activity 1: Implement a program to monitor long-term trends and establish a baseline of the current level of nonconsumptive use, through collaboration with the Koyukuk/Nowitna National Wildlife Refuge and commercial operations in Unit 21D.

METHODS

Previously established TCAs, of 4–6 contiguous "Gasaway" sample units, were surveyed from small fixed-wing aircraft (PA-18 or similar aircraft) to assess moose population parameters (Gasaway et al. 1986). Surveys were flown at an altitude of approximately 500 feet and at ground speeds of 70–80 mi/hr. Moose were classified as cows, calves, yearling bull (<30" antler spread and no brow tine definition), medium bull (<50" antler width), or large bull (≥50" antler width). Sample units of approximately 12 mi^2 each were searched at a rate of approximately

5 min/mi^2 to ensure reasonably high sightability, minimal bias, and data comparability among years. Data was recorded on standard data forms and moose locations were also recorded on 1:63,000 USGS quadrangle maps. Surveys were not conducted until a minimum snow cover of approximately 12 inches had accumulated. This level of snow cover is important because snow depth influences sightability and moose distribution.

Population estimation surveys were conducted in October and November 2001 and 2002 using similar techniques described by Gasaway et al. (1986) but modified for analysis using the Geostatistical Spatial Population Estimator (GSPE) (Ver Hoef 2001). Sample units averaged 5.6 mi^2 in size, with search intensity of ~6 min/mi^2. Sample units were located by latitude–longitude coordinates using in-flight GPS units. Of the 975 sample units in the survey area, 291 sample units were surveyed intensively with an average survey time of 30.8 minutes per 5.6 mi^2 sample unit. Nine hundred seventy-five sample units were stratified in advance of the intensive survey, with 255 of the sample units classified as high moose density, while the remaining 720 sample units were classified as low moose density.

Twinning surveys were flown in May to determine the proportion of moose calf twins in the TCA. Search and survey techniques and sample units were similar to those used in early winter. Observation of 50 cows with calves was the desired minimum, but funding and weather often prevented us from achieving that goal. Moose were classified as bull, yearling, calf, cow, cow with 1 calf, or cow with 2 calves. The timing of the surveys was critical. The surveys occurred when calving progressed to the point that approximately 50% of the cows observed had calves, yet mortality factors such as early black bear predation did not strongly influence the results.

Hunting mortality and harvest distribution were monitored through the statewide harvest ticket system, registration permits, limited drawing permits, door-to-door subsistence surveys, and a checkstation. General season hunters received 1 reminder letter to report harvest. Hunters with registration, drawing, or Tier II permits received 1 postcard reminder, a telephone call, and a certified letter. The permittee was prohibited from receiving the following year's permit if no harvest information was relayed to ADF&G. Information obtained from the reports and surveys was used to determine total harvest, harvest location, hunter residency and success, harvest chronology, and transportation used. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY99 = 1 Jul 1999–30 Jun 2000). Data collected at the checkstation included hunter residency, harvest chronology, time in the field, hunting party size, sex and age structure of harvest, antler size, method of harvest, location of harvest, caliber of firearm, and method of transportation.

We evaluated predation by interviewing trappers, by field observations, and through aerial wolf surveys flown in cooperation with the US Fish and Wildlife Service (FWS).

Vegetation surveys were conducted in spring 2002 in the Lower Koyukuk River drainage. Several browse communities were evaluated to determine species that occur, vigor of the stand, current annual production and the amount of browsing that plants had incurred (CT Seaton, personal communication).

We continued with the planning process during the reporting period to address concerns over continued increase of hunters in the Koyukuk River Drainage. The planning process was

initiated in winter 1999, and a Koyukuk River Moose Hunter's Working Group (KWG) was formed from members of the state's advisory committees, the Federal Western Interior Subsistence Council, and a local guide representative. The planning group developed a draft 5-year Koyukuk River Moose Management Plan (ADF&G files) that was submitted to the Alaska Board of Game during the March 2000 meeting. The draft plan was used as a guide for management goals, objectives, activities, and biological decision-making criteria in this management report. The board, in their January 2001 meeting, endorsed the plan.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

As noted in the previous report, the unitwide moose population increase that was observed for almost 2 decades had ended and some localized areas showed marked declines. Peak densities of moose were apparently reached between 1993 and 1997, but declining calf numbers and recruitment of yearlings began to be apparent in fall 1998 and 1999 in most TCAs (Tables 1–8). Estimates of the number of calves and yearlings that were apparently lost during 1998–2001 in the Three Day Slough area suggested a decline of as much as 25%. Since 1997 the total population may have declined by 10–15%, and the population trend is downward. Counts from several TCAs during 1999–2001 supported this conclusion, as did the population estimation survey conducted in 2001. However, steep declines that were first observed in the TCAs between 1997 and 2001 seemed to be largest in the high-density areas, while the low-density areas appeared to remain stable and productive. Those areas of productivity may have mediated the decline over the whole population.

My population estimate of 8500–9500 moose is based on previously reported values, trend count surveys conducted in RY01 and RY02, and the population estimation survey completed in 2001. Declining recruitment of moose among the trend areas was a key indicator of the apparent overall decline in the population. However, the 2001 survey showed that in the low-density areas not surveyed annually, moose numbers apparently remained relatively stable. In fall 2001, 5526 mi^2 were surveyed in Unit 21D and the southern portion of Unit 24. Of the 975 sample units in the survey area, 291 sample units were surveyed intensively. We counted 4524 moose during the intensive surveys with an average survey time of 30.8 minutes per 5.6 mi^2 sample unit. Nine hundred seventy-five sample units were stratified in advance of the intensive survey, with 255 of the sample units classified as high moose density, while the remaining 720 sample units were classified as low moose density. In the 3577-mi^2 portion of Unit 21D that was surveyed, we estimated 5203 moose (Table 9). In the remaining 8536 mi^2 of Unit 21D not surveyed, I estimated an average density of 0.45 moose/mi^2 or 3841 moose.

Population Composition

The following guidelines were used to interpret sex and age indices (Franzmann and Schwartz 1998).

- Bull:cow ratios in some of the high density TCAs were in excess of 30–40 bulls:100 cows after the fall hunting season. Ratios of 15 bulls:100 cows are sufficient for breeding

(Woolington 1998) in these areas, with higher ratios providing increased harvest or trophy hunting opportunity. High numbers of bulls are sometimes misleading in terms of harvest effects on the population because Unit 21D is subject to either-sex hunting which can inflate bull ratios.

- The calf:cow ratio observed during November surveys provides an index to calf survival during the calves' first 5 months. Black bears, grizzly bears, and wolves were the primary predators that reduced calf numbers (Osborne et al. 1991). A November calf:cow ratio of 20–40 calves:100 cows will usually allow a population to remain stable. Calf:cow ratios may indicate population change if subsequent overwinter mortality is either consistent or negligible. Ratios of <20 calves:100 cows may indicate a decreasing population and ratios of >40 calves:100 cows can be found in growing populations.

- The percentage of yearling bulls within the herd provides an index of the recruitment of young adults to the breeding population. It can also provide an indication of overwinter survival of calves, if the calf:cow ratio for the previous fall is known. Generally, the yearling bull percentage averages 4–8%, with anything less indicating poor recruitment and with anything higher indicating good recruitment.

- The number of twins born in May is often used as an indication of herd nutritional status. In general, the twinning rates are 25–90% in populations below carrying capacity, 5–25% in populations near carrying capacity, and <5% in populations above carrying capacity (Gasaway et al. 1992).

Since 1995 the post hunt bull:cow ratio for the Three Day Slough TCA was generally declining, with the fall 1999 ratio being the lowest recorded (Table 1). Bull:cow ratios vary widely between other TCAs (Tables 2–8), but most indicate some level of decline since 1995 or 1996. The percentage of large bulls (antlers ≥50") observed in the Three Day Slough TCA was 15–30% in the 1990s, while the percentage of large bulls in the harvest from Three Day Slough was 40–68% (Table 10). The drop in RY01 may be attributed to extremely warm weather during the fall hunting season. Bull:100 cow ratios from the 2001 GSPE survey were estimated at 33:100, well above the minimum needed for adequate productivity. For the survey area of 2001, the calf:100 cow ratio was estimated at 18:100. That calf ratio was lower than the target range (20–40:100) for maintaining a stable population. Data from most of the TCA's had even lower ratios however, which suggested the low density areas away from the TCA's maintained higher levels of productivity and probably acted to moderate the overall decline of the population.

Calf twinning rates in spring 2002 suggested declining productivity in the Three Day Slough area and the Huslia Flats area just to the north in Unit 24. Twinning rates appeared to be consistently in the low teens. Although only 16 cow/calf groups were observed in the Three Day Slough area in the 2002 survey, additional groups counted in the Huslia Flats area to the north had similar results (Table 11). In both areas, early leaf-out on the willows, birch and cottonwoods made sighting moose difficult.

Distribution and Movements

Movement patterns of moose in the Three Day Slough area are based on data from radiocollared animals (Osborne and Spindler 1993). Most adult and young moose remain in the floodplain area of Three Day Slough from late August until May each year. During May most moose move 10–60 miles north or south to upland areas where they spend the summer. In August they return to the floodplain area.

Moose movements are unknown in other portions of the subunit. However, local residents suspect some moose observed on the Kaiyuh Flats migrate seasonally to the south.

Generally, moose congregate along the river corridors in late fall with the approach of peak rutting season. With the accumulation of snow, moose are in high concentrations within the riparian corridor of the Yukon and Koyukuk Rivers, where they remain throughout the winter. With spring break-up, bulls are the first to leave the riparian areas, followed by cows that have calved. Osborne and Spindler (1993) found approximately 58% of the cows migrated after calving and approximately 83% of all moose were migratory.

MORTALITY

Harvest

Season and Bag Limit.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 21D, that portion within the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 moose per regulatory year, only as follows:		
1 moose by registration permit only; or	27 Aug–31 Aug (Subsistence hunt only)	
1 bull by registration permit only; or	1 Sep–20 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Unit 24, that portion within the Koyukuk Controlled Use Area; or	5 Sep–25 Sep (General hunt only)	
1 moose during a 5-day season to be announced by emergency order during the period 1 Feb–28 Feb.	(To be announced) (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side		5 Sep–25 Sep

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
by drawing permit; up to 80 permits may be issued in combination with Unit 24, that portion within the Koyukuk Controlled Use Area;		
Remainder of Unit 21(D)		
RESIDENT HUNTERS: 1 moose per regulatory year; however, antlerless moose may be taken only during the periods 21 Sep–25 Sep and during a 5-day season during the period 1 Feb–28 Feb to be announced by emergency order;	5 Sep–25 Sep (To be announced)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. The antlerless moose hunting seasons were reauthorized by the Alaska Board of Game for RY00 and RY01, but the board was notified that the antlerless season would be closed by emergency order for the fall 2002 season for conservation concerns.

The board adopted several changes proposed by the KWG at the March 2000 meeting. Key among those changes was the elimination of the general registration hunt and implementation of 4 drawing hunts within the KCUA. Drawing hunts DM827 and DM829 were the nonresident hunts and DM828 and DM830 were the resident hunts. The DM827 and DM828 hunts were for the first half of the season, while DM829 and DM830 hunts were for the second half of the season. The total number of permits were determined annually by the department based on population estimates and were allocated on a 80:20 ratio for resident and nonresidents. All drawing hunts were for bulls-only hunts, with nonresidents limited to bulls with 50-inch antlers or 4 or more brow tines on at least one side. The board shifted the RM832 registration hunt forward 5 days to begin 27 August and close 20 September. Finally, the permit area was expanded to include all of the Koyukuk Controlled Use Area. Previously, the permit area ended at the village of Huslia.

At the 2002 meeting, the board adopted more changes to the moose regulations in Unit 21D, requiring all the meat to remain on the bone of the 4 quarters and the ribs for the remainder of the unit. The regulation that applied to the winter seasons requiring hunters to stay one-half mile from the main stem of the Yukon River was dropped. The final action of the board was to prohibit the harvest of cows accompanied by calves.

Hunter Harvest. The reported harvest of moose in Unit 21D increased substantially since the early 1990s (Tables 12–14). Increased hunter numbers occurred primarily in the lower Koyukuk River drainage and to a lesser degree in the remainder of the unit. Interest in hunting the Koyukuk River grew particularly in the last decade. The decline in the bull segment of the population in some TCAs is probably linked to this increased harvest. Cow harvest was reduced in RY00 primarily due to elimination of the antlerless moose seasons in the KCUA.

Wounding loss was a concern of the KWG. During their meetings, they established that wounding loss constituted an important portion of the harvest that should be evaluated and documented. Values in the literature for wounding loss were 10–20% (Franzmann and Schwartz 1998). Gasaway et al. (1983) estimated 15% wounding loss and unreported harvest in Alaska.

Checkstation Results. Ella's Cabin checkstation, located 15 miles upstream from the village of Koyukuk on the Koyukuk River, was made mandatory in RY90. Hunters checking in at Ella's reached an all-time high in RY99, but the number dropped significantly with the implementation of the limited drawing hunts in RY00. The additional hunters in the KCUA were primarily nonlocal Alaska residents and, secondarily, nonresidents (Table 14). Numbers of local residents (residents of Unit 21D) remained relatively constant. Harvest success was high (>60%) for nonresidents and nonlocal residents. Local resident harvest success that was reported for the fall hunt was low, because they can hunt in both fall and winter seasons. Success rates remained high except for RY01, but that was due to the extremely warm weather during the fall hunting season.

The Three Day Slough area is well known as an excellent area to hunt for large (≥50-inch antlers) moose. One-fifth to one-third of the bulls observed in the Three Day Slough TCA had large antlers (Table 10). Consistently over the past 18 years, more than 16% of the bulls checked at Ella's Cabin had antler spreads >60 inches.

Three regulations monitored closely at the checkstation were antler width, salvage of meat, and destruction of trophy value of bulls harvested under subsistence registration permits. The regulation requiring meat to be left on the bone improved enforcement efforts to stop waste of moose meat. This regulation was passed in 1992 to address the increase of moose hunters and harvest in the KCUA, and to address the problem of some hunters removing only part of the meat from the carcass so they could carry lighter loads in their boats. All hunters coming through the checkstation were notified of this regulation at the time permits were distributed. Hunters were then checked for compliance of the regulation upon departure. Destruction of the trophy value of antlers at the checkstation was a controversial regulation when applied and seldom resulted in a positive public contact for the department. Beginning in RY00, hunters were required to cut the antlers at the kill site, which improved that aspect of the hunter contact.

Permit Hunts. Use of the subsistence registration permit (RM832) hunt was required in the fall within the entire Koyukuk Controlled Use Area. The number of RM832 permits issued for RY01 increased by 13.5% from the previous year (Table 15). Continued increases in the number of Alaska resident hunters using the subsistence permit alternative may exceed the sustainable yield of the moose population and has been a critical management issue. With the implementation of the 4 drawing hunts DM827, DM828, DM829 and DM830, hunter numbers can be better regulated.

Hunter Residency and Success. Hunter residency and success can be misleading because Unit 21D residents often did not report unsuccessful hunt information (Table 16). Harvest and hunter participation by Unit 21D residents was relatively constant according to Subsistence Division surveys (Anderson et al. 1998; Table 16). In contrast, nonresident and nonlocal resident hunter participation increased steadily since 1983. The increase in nonlocals created tension among user groups in the area and was the impetus for creating the KWG.

Harvest Chronology. Harvest reporting rate was low during the winter seasons and was probably 20% of the annual harvest (Table 17). Much of the unreported harvest was likely taken during October–March (Anderson et al. 1998).

Transportation Methods. The presence of the KCUA and the area's extensive river system made boats the primary transportation method (Table 18). Snowmachines were the main transportation during the winter hunt.

Other Mortality

Unit 21D has high populations of wolves and black bears. Grizzly bears were common in the upland areas of the Nulato Hills and Kaiyuh Mountains. Wolves and grizzly bears prey heavily on both calf and adult moose. Black bears were shown to kill more than 40% of moose calves annually (Osborne et al. 1991). Hunters continued to report increased observations of grizzly bears during the fall moose season. Anecdotal reports from Unit 21D residents also suggested grizzly bears were increasing and becoming more common intruders at their fish camps.

We estimated 208–304 wolves in 37 packs in a portion of Unit 21D during 1994 (Becker et al. 1998). Local residents with intimate knowledge of the unit's game populations report wolf numbers substantially increased since then. Packs in excess of 20 wolves were observed during fall 1999 moose surveys. We counted 126 wolves during a wolf reconnaissance survey in March 1999. This minimum count indicates an increase of at least 17% in the number of wolves in packs also observed during the 1994 survey.

HABITAT

Assessment

Feltleaf willow is an important browse species for moose due to its nutritional quality and use (Kielland 1997). Chemical analysis of 0.08- to 0.32-inch diameter twigs typically browsed by moose in Three Day Slough found crude protein was 8–12%, twice as much as found in the same willow species on the Tanana River. Consumption in Three Day Slough survey areas was 24–28% of the annual twig production (Kielland 1997). These factors may partly explain the sustained high numbers of moose in the Three Day Slough area. Annual forage production for a measurable area is unknown.

In April 2002 we conducted 6 browse transects in Unit 21D to evaluate sampling techniques that could potentially be used in the Galena Management Area.

MANAGEMENT PLANNING

The KWG met twice in RY01 and RY02, and the Management Plan (ADF&G files) developed by the working group was formally endorsed by the Board of Game at their winter 2001 meeting. The plan was the basis for developing goals and activities for moose management in Unit 21D. Although the KWG's area of concern was specifically within the Koyukuk River drainage, the issues were characteristic of concerns throughout Unit 21D and nearby Unit 24.

CONCLUSIONS AND RECOMMENDATIONS

Moose were relatively numerous in the riparian lowlands of Unit 21D. I estimated 8500–9500 moose in the unit. However, unitwide populations were declining as a result of declining recruitment. Four years of liberalized cow harvest removed an important reproductive component of the population. Also, declining recruitment parameters such as calf:cow ratios and yearling bull:cow ratios indicated predation was having an increasingly negative influence on the moose population. This conclusion is supported by the increase in wolves observed during the aerial wolf reconnaissance survey in 1999, observations of black bear predation during spring twinning surveys, observations of black bears in the field, and increased observations of grizzly bears by hunters. The population will continue to decline unless an effort to control predation is implemented and the harvest of antlerless moose continues to be decreased.

All hunters in the KCUA use boats, and during years with low water levels there is competition for camping sites and moose calling areas, and other problems associated with crowded hunting conditions. Historically, the area has been known for its remote qualities, where people had the opportunity to select a bull, watch bulls rut, and hunt and observe other wildlife such as bears and waterfowl.

The objective of maintaining the population at 9000–10,000 moose was achieved by a narrow margin. Poor recruitment, due in part to unregulated predation, appears to be the primary factor, although declining twinning rates suggest habitat could be linked to the decline. The objective to provide for a harvest of moose not to exceed 700 moose was achieved. From RY99–RY01, harvest was highest in RY99 at 619 moose, a harvest rate of no more than 6.9%, even if the population was at it lowest point of 9000 moose. Objective 3 was achieved with a total of only 588 hunters in RY00 and 509 in RY01.

The long-term objective of implementing at least 2 habitat enhancement activities was not achieved directly, but baseline data were collected on browse communities in Unit 21D and observations were made during survey flights that will be used in developing plans for potential treatment areas. Coordination with the FWS concerning potential treatment is in progress.

The objective of reducing spoiled meat will be monitored in RY02. It is believed that regulations adopted by the board that required salvage of meat on all 4 quarters and the ribs in all of Unit 21D was a positive move toward achieving this objective. Finally, as with the previous objective, a monitoring program to evaluate the number of people engaged in nonconsumptive activities is being developed. Coordination with the FWS on this objective has taken place and survey forms have been developed to monitor nonconsumptive wildlife activities.

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Table 1 Unit 21D Three Day Slough trend count area aerial moose composition counts, regulatory years 1981–1982 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1981–1982[a]	85.1	35	12	42	10	24	327	3.8
1982–1983[a]	85.1	43	13	24	2	14	415	4.9
1983–1984	84.8	31	9	37	12	22	530	6.3
1984–1985	57.8	30	13	31	10	19	332	5.7
1985–1986	83.3	39	11	17	4	11	501	6.0
1986–1987	83.3	39	7	45	13	25	660	7.9
1987–1988[a]	83.3	36	13	32	11	19	791	9.5
1988–1989	83.3	33	13	45	14	25	832	10.0
1989–1990	83.3	28	8	25	11	16	763	9.2
1990–1991[b]								
1991–1992[a]	83.3	34	10	31	6	19	909	10.9
1992–1993	83.3	35	10	31	7	18	1088	13.1
1993–1994[a]	83.3	38	8	25	4	16	1106	13.3
1994–1995	83.3	36	9	28	5	17	1026	12.3
1995–1996	83.3	23	7	36	6	23	1054	12.7
1996–1997	83.3	24	8	23	4	15	928	11.1
1997–1998	83.3	20	9	24	3	17	721	8.7
1998–1999	83.3	30	9	13	0	9	990	11.9
1999–2000	83.3	17	3	17	18	13	568	6.9
2000–2001[b]								
2001–2002	83.3	22	7	13	0	8	678	8.0

[a] Huntington and Spindler 1997.
[b] No survey.

Table 2 Unit 21D Dulbi River mouth trend count area aerial moose composition counts, regulatory years 1982–1983 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1982–1983	42.1	36	7	29	12	17	166	3.9
1983–1984	57.1	39	7	29	8	17	230	4.0
1984–1985	42.1	36	4	44	10	24	184	4.4
1987–1988	38.9	55	17	44	15	22	283	7.3
1992–1993	51.7	41	6	43	21	23	271	5.2
1996–1997	51.7	34	11	36	6	21	281	5.4
1997–1998	52.4	28	6	32	4	20	283	5.4
1999–2000	52.4	24	2	42	2	25	225	4.3
2000–2001	52.4	16	6	15	6	12	307	5.9
2001–2002	52.4	25	6	14	5	10	217	4.1

Table 3 Unit 21D Kateel River mouth aerial moose composition counts, regulatory years 1984–1985 through 1997–1998 (Huntington and Spindler 1997)

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1984–1985	47.8	21	8	54	5	31	68	1.4
1987–1988	38.0	41	20	41	12	23	84	2.2
1996–1997	49.4	46	15	29	14	16	152	3.1
1997–1998	61.1	26	10	34	0	21	188	3.1

Table 4 Unit 21D Long Stretch (Koyukuk River) aerial moose composition counts, regulatory years 1984–1985 through 1997–1998 (Huntington and Spindler 1997)

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1984–1985	51.5	94	31	31	25	14	36	0.7
1996–1997	51.3	36	6	61	25	31	65	1.3
1997–1998	62.5	47	7	33	0	18	77	1.2

Table 5 Unit 21D Koyukuk River mouth aerial moose composition counts, regulatory years 1984–1985 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1984–1985	65.5	27	10	41	5	25	183	2.8
1987–1988	37.8	28	8	49	12	28	69	1.8
1993–1994	51.2	43	10	36	6	20	175	3.4
1996–1997	51.2	42	6	45	7	24	181	5.1
1997–1998	66.5	35	6	50	10	27	284	4.3
1999–2000	66.5	36	10	19	6	13	288	4.4
2001–2002	66.5	41	8	17	0	11	267	4.0

Table 6 Unit 21D Squirrel Creek aerial moose composition counts, regulatory years 1981–1982 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1981–1982	40.7	93	49	34	8	15	93	2.3
1982–1983	37.3	57	18	41	0	21	87	2.3
1983–1984	37.3	58	14	35	14	18	137	3.7
1985–1986	49.3	78	30	11	13	6	185	3.8
1987–1988	38.4	76	20	67	20	27	131	3.4
1993–1994	37.2	49	4	22	0	13	195	5.2
1995–1996	48.8	43	14	31	8	18	222	4.6
1997–1998	48.6	54	24	32	8	17	253	5.2
1998–1999	48.6	41	12	31	13	18	283	5.9
1999–2000	48.6	69	19	24	3	13	246	5.1
2000–2001	48.6	47	9	14	6	9	223	4.6
2001–2002	48.6	46	5	25	2	15	289	6.0

Table 7 Unit 21D Pilot Mountain Slough aerial moose composition counts, regulatory years 1983–1984 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1983–1984	36.5	21	8	52	11	30	133	3.6
1984–1985	36.5	11	2	47	39	30	84	2.3
1985–1986	36.5	27	11	9	0	7	90	2.5
1987–1988	35.7	36	18	49	11	26	185	5.2
1991–1992	23.2	24	8	54	14	30	161	6.9
1993–1994	35.4	21	1	39	10	24	135	3.8
1995–1996	34.3	20	14	57	14	32	203	5.9
1997–1998	47.3	12	4	32	11	22	222	4.7
1998–1999	47.3	18	6	28	2	19	297	6.3
1999–2000	47.3	18	8	39	3	25	243	5.1
2001–2002	47.3	26	9	40	7	24	238	4.8

Table 8 Unit 21D Kaiyuh Slough aerial moose composition counts, regulatory years 1985–1986 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1985–1986	50.8	54	17	8	0	5	78	1.5
1987–1988	39.1	28	7	33	7	20	74	1.9
1992–1993	50.8	36	18	24	22	15	72	1.4
1994–1995	50.8	44	12	31	0	18	119	2.3
1996–1997	64.3	60	13	67	6	30	125	1.9
1997–1998	64.3	35	12	39	10	23	146	2.3
1998–1999	64.3	42	18	48	10	25	173	2.7
1999–2000	64.3	39	12	22	13	14	123	1.9
2000–2001	64.3	41	9	31	15	18	127	2.0
2001–2002	64.3	55	4	7	0	5	112	1.8

Table 9 Unit 21D moose population estimates of 1997 and 2001 population estimation surveys

Survey area	1997 Population estimate[a]	1997 Survey area (mi^2)	2001 Population estimate[b]	2001 Survey area (mi^2)
Kaiyuh Slough Sub-Area	1335 ± 230	1582	1800 ± 591	1843
Western Galena Sub-Area	3250 ± 403	1508	3403 ± 603	1734
Upper Koyukuk Sub-Area[c]	n/a	n/a	3642 ± 572	1949
Total Survey Area	4585 ± 633	3090	8924 ± 1161	5526

[a] Regression Analysis Estimate
[b] Spatial Analysis Estimate
[c] Predominantly within Unit 24

Table 10 Unit 21D large bull[a] moose percent harvested and number measured during the hunting season and percent counted during aerial surveys in the Three Day Slough area, regulatory years 1990–1991 through 2001–2002

Regulatory year	% Harvested (Sep)	Number measured (Sep)	% Counted (Nov)
1990–1991	54	91	–[b]
1991–1992	45	134	15
1992–1993	54	88	15
1993–1994	53	107	18
1994–1995	67	88	28
1995–1996	61	150	27
1996–1997	68	123	20
1997–1998	63	120	16
1998–1999	61	209	30
1999–2000	65	220	21
2000–2001	37	119	–[b]
2001–2002	40	83	30

[a] 50-inch or greater antler spread.
[b] No survey.

Table 11 Unit 21D moose aerial twinning surveys in the Three Day Slough trend count area, regulatory years 1989–1990 through 2001–2002

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[a]	Yearlings	Dates in May
1989–1990		24	21	47		21–25
1991–1992		22	23	51		22–23
1992–1993	296	23	19	44	100	23–25
1993–1994	110	39	11	22	55	23–24
1994–1995	78	37	18	33	38	22
1995–1996	200	39	13	26[b]	51	22,24
1996–1997	180	30	9	23	58	23–24
1997–1998	70	29	4	12	11	20–30
1998–1999	28	37	3	8	14	4–7[c]
1999–2000	101	53	8	13	47	27–29
2000–2001		38	6	14		28–30
2001–2002	30	13	3	19	2	29–1

[a] Percent of cows with calves that had twins.
[b] Including 1 cow w/3 calves.
[c] The 1999 survey was delayed to 4–7 June due to weather.

Table 12 Unit 21D moose harvest, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest by hunters				Unreported harvest	Potlatch stickdance	Total
	Bull	Cow	Unk	Total			
1990–1991	258	24	1	283	40	4	327
1991–1992	269	34	0	303	40	11	354
1992–1993	193	22	1	216	40	11	267
1993–1994	235	23	2	260	40	9	309
1994–1995	248	26	1	275	40	8	323
1995–1996	329	21	1	351	40	4	395
1996–1997	315	110	1	426	150[a]	4	580
1997–1998	336	73	1	410	150[a]	4	564
1998–1999	340	80	3	423	150[a]	1	574
1999–2000	336	127	3	466	150[a]	3	619
2000–2001	320	35	0	355	150[a]	10	515
2001–2002[b]	206	40	2	248	150[a]	13	411

[a] Unreported harvest based on Subsistence Division's door-to-door survey.
[b] Preliminary data.

Table 13 Ella's Cabin checkstation moose harvest, regulatory years 1990–1991 through 2001–2002[a]

Regulatory year	Bull	Cow	% Cow	Total
1990–1991	177	6	3	183
1991–1992	199	10	5	209
1992–1993	161	6	4	167
1993–1994	179	6	3	185
1994–1995	192	10	5	202
1995–1996	279	8	3	287
1996–1997	263	90	25	353
1997–1998	257	49	16	306
1998–1999	284	61	18	345
1999–2000	275	94	25	369
2000–2001	266	11	4	278
2001–2002	183	3	2	187

[a] Contains moose harvested in Units 21D and 24.

Table 14 Ella's Cabin checkstation[a,b] moose hunter residency and success, regulatory years 1983–1984 through 2001–2002

Regulatory	Unit 21D resident		Alaska resident[c]		Nonresident		Total	
year	Hunter	Moose	Hunter	Moose	Hunter	Moose	Hunter	Moose
1983–1984[d]	132	43	29	20	3	2	164	65
1984–1985[d]	92	61	67	36	9	9	168	106
1985–1986[d]	117	32	74	37	4	3	195	72
1986–1987[d]	140	48	80	51	9	7	229	106
1987–1988[d]	151	68	92	61	21	16	264	145
1988–1989[d]	158	73	121	88	20	20	299	181
1989–1990	154	55	125	89	23	14	302	158
1990–1991	137	48	133	105	36	30	306	183
1991–1992	136	49	189	121	55	38	380	209
1992–1993	145	45	173	103	39	19	357	167
1993–1994	115	48	132	109	34	28	281	185
1994–1995	106	34	194	127	56	41	356	202
1995–1996	124	49	260	188	63	50	447	287
1996–1997	213	90	306	198	89	66	608	354
1997–1998	157	66	278	185	89	55	524	306
1998–1999	155	58	344	213	126	74	625	345
1999–2000	180	68	383	210	173	91	736	369
2000–2001	203	77	261	175	43	26	507	278
2001–2002	199	49	287	124	35	14	521	187

[a] Includes hunters from both Units 21D and 24.
[b] Includes hunters reporting at Huslia.
[c] Other than Unit 21D residents.
[d] Check not mandatory prior to 1990.

Table 15 Units 21D and 24 Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 1998–1999 through 2001–2002[a]

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk	Total harvest
RM832	1998–1999	295	0	45	55	125 (77)	38 (23)	0	163
	1999–2000	356	0	49	51	127 (70)	54 (30)	1	182
	2000–2001	355	8	44	48	157 (93)	11 (7)	1	169
	2001–2002[b]	403	8	60	32	126 (97)	3 (2)	1	130
RM830	1998–1999	330	0	45	55	159 (87)	23 (13)	0	182
	1999–2000	380	0	51	49	148 (79)	39 (21)	0	187
DM827	2000–2001	26	15	42	38	10 (100)	0 (0)	0	10
	2001–2002[b]	26	19	50	23	5 (83)	1 (7)	0	6
DM828	2000–2001	103	51	11	37	38 (100)	0 (0)	0	38
	2001–2002[b]	103	63	19	17	17 (100)	0 (0)	0	17
DM829	2000–2001	26	15	23	62	16 (100)	0 (0)	0	16
	2001–2002[b]	26	15	31	31	8 (100)	0 (0)	0	8
DM830	2000–2001	103	41	15	44	45 (100)	0 (0)	0	45
	2001–2002[b]	103	51	19	25	26 (100)	0 (0)	0	26
Total	1998–1999	625	0	45	55	284 (82)	61 (18)	0	345
	1999–2000	736	0	50	50	275 (75)	93 (25)	1	369
	2000–2001	613	22	28	45	266 (96)	11 (4)	1	278
	2001–2002[b]	661	24	41	28	182 (97)	4 (2)	1	187

[a] RM830 ended in RY00 and was replaced by Drawing Hunts DM827, 828, 829, and 830.
[b] Preliminary data.

Table 16 Unit 21D moose hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	
1990–1991	103	135	35	10	283	34	27	4	6	71	354
1991–1992	105	150	42	6	303	60	97	16	3	176	479
1992–1993	72	111	23	10	216	56	82	14	15	167	383
1993–1994	87	141	24	8	260	55	27	7	2	91	351
1994–1995	80	148	44	3	275	47	68	13	0	128	403
1995–1996	90	203	54	4	351	41	77	9	0	127	478
1996–1997	135	218	70	3	426	127	143	34	1	305	731
1997–1998	127	226	57	0	410	110	104	52	0	266	676
1998–1999	100	232	88	3	423	124	180	76	1	381	804
1999–2000	126	232	104	4	466	140	202	121	1	464	930
2000–2001	111	198	45	1	355	78	107	48	0	233	588
2001–2002[b]	77	145	21	5	248	68	152	40	1	261	509

[a] Subunit resident only.
[b] Preliminary data.

Table 17 Unit 21D moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2001–2002

Regulatory year	Harvest chronology percent by month/day			
	9/1–9/14	9/15–9/25	2/1–2/10	*n*
1996–1997	53	43	4	423
1997–1998	59	37	4	446
1998–1999	50	49	1	386
1999–2000	48	47	5	456
2000–2001	48	47	4	348
2001–2002[a]	33	63	5	243

[a] Preliminary data.

Table 18 Unit 21D moose harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	Total
1990–1991	4	0	88	0	3	0	2	2	283
1991–1992	5	0	86	0	5	0	2	2	303
1992–1993	3	0	88	1	3	0	2	3	216
1993–1994	3	0	88	1	5	0	1	2	260
1994–1995	4	0	85	0	7	1	2	1	275
1995–1996	3	0	91	1	2	1	2	0	351
1996–1997	2	0	91	1	4	0	2	1	426
1997–1998	4	0	90	1	4	0	1	0	410
1998–1999	5	0	88	0	3	1	2	1	423
1999–2000	2	0	90	0	5	1	1	2	466
2000–2001	3	0	90	1	4	1	1	1	355
2001–2002[a]	2	0	92	1	4	0	1	0	248

[a] Preliminary data.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 24 (26,055 mi^2)

GEOGRAPHIC DESCRIPTION: Koyukuk River drainage above Dulbi River

BACKGROUND

Moose are broadly distributed throughout much of Unit 24 with densities (0.5–2.0 moose/mi^2) that are typical of Interior Alaska. Anecdotal evidence indicates the population was low prior to the 1930s, but increased during the 1930s–1950s (Huntington 1993). The rate of increase was probably slow until predator control efforts in the 1950s allowed rapid expansion of local populations, especially in the southern third of the unit. During the early 1970s the population reached a peak and mortality started to exceed recruitment in some areas. Populations apparently climbed again in the late 1980s, peaked around 1992, then fell gradually through the remainder of the 1990s.

Naturally occurring wildfires and floods are major forces affecting the productivity and diversity of moose habitat in this area. Habitat is excellent along most of the Koyukuk River lowlands, providing extensive areas of winter browse. Lightning-caused fire is a frequent event and large areas of the burned uplands are productive browse communities. Based on personal observations, browse production does not appear to be limiting the size of the moose population at current moose densities.

The Koyukuk River and major tributaries are popular moose hunting areas for unit residents, other Alaska residents, and nonresidents. The lower portion of the Koyukuk within Unit 24 has been the focus of most of our management effort because of the long history of use, higher moose densities, and increasing hunting activity. Hunting activity has also been increasing in other areas of the unit, including rivers accessible from the Dalton Highway. Two controlled use areas (CUA), the Koyukuk CUA and the Kanuti CUA, restrict use of aircraft for moose hunting activities. The Dalton Highway Corridor Management Area (DHCMA) prohibits use of off-road vehicles and firearms for hunting within 5 miles on either side of the Dalton Highway. Access to portions of the unit has increased with the opening of the highway.

There are several moose hunting seasons in Unit 24 that reflect the variety of moose densities and human-use patterns. In addition to the usual September hunting season, open seasons in December and March also provide hunting opportunity for residents of Alaska. A registration permit moose hunt was also established in 1996 in the Koyukuk CUA, downstream from Huslia.

Annual reported harvests during the past 25 years were 44–230, but did not exceed 100 moose until 1980. Unreported harvests during this period probably were 160–300 moose per year (Woolington 1998). Since 1980, reported harvests have exceeded 100 moose each year. Local residents have become more aware of the importance of harvest reporting, resulting in increased compliance with reporting requirements.

MANAGEMENT DIRECTION

Management goals and objectives were formed during the previous reporting period, as part of the planning process.

GOAL 1: Manage Koyukuk River drainage moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

Objective 1: Maintain a moose population of 10,000–12,000.

Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

Objective 2: Provide for a harvest of moose, not to exceed 360 moose or 5% of the annual moose population estimate each regulatory year.

Activity 1: Monitor hunter use levels in the Koyukuk River drainage.

Activity 2: Monitor impacts (social and environmental) to private property and local residents by Koyukuk River moose hunters.

Activity 3: Develop programs to improve population and harvest data for moose in Unit 24.

Objective 3: Provide for moose hunting opportunity, not to exceed 500 hunters per regulatory year.

GOAL 2: Protect and enhance moose habitat.

Objective 1: In combination with Unit 21D, implement at least 2 habitat enhancement activities every 5 years.

GOAL 3: Reduce meat spoilage by hunters.

Objective 1: Reduce the amount of spoiled meat observed at Ella's Cabin and at hunting camps by 10% each regulatory year.

Activity 1: Implement a program at Ella's Cabin checkstation to monitor percentage of meat lost due to spoilage.

GOAL 4: Maintain opportunities for wildlife viewing, photography and other nonconsumptive uses of wildlife within the Koyukuk River drainage.

Objective 1: Increase the number of people engaging in nonconsumptive uses of wildlife by >1% each regulatory year.

Activity 1: Implement a program to monitor long-term trends and establish a baseline of the current level of nonconsumptive use, through collaboration with the Koyukuk/Nowitna and Kanuti National Wildlife Refuges, the Gates of the Arctic National Park and Preserve, and commercial operations in Unit 24.

METHODS

We surveyed established trend count areas (TCA) of 4–6 contiguous "Gasaway" sample units from small fixed-wing aircraft (PA-18 or similar aircraft) to assess moose population parameters (Gasaway et al. 1986). Surveys were flown approximately 500 ft above ground level and at ground speeds of 70–80 mi/h. Moose were classified as cows, calves, yearling bull (<30" antler width and no brow tine definition), medium bull (<50" antler width), or large bull (≥50" antler width). Sample units of approximately 12 mi^2 each were searched at a rate of approximately 5 min/mi^2 to ensure reasonably high sightability, minimal bias, and data comparability among years. Data was recorded on standard data forms and moose locations were also recorded on 1:63,000 USGS quadrangle maps. Surveys were not conducted until a minimum snow cover of approximately 12 inches had accumulated. This level of snow cover is important because snow depth influences sightability and moose distribution.

We conducted a population estimation survey (ADF&G files, Galena, 12 May 2000) in fall 1999 in the northern portion of Unit 24 that covered 8390 mi^2. Data from that survey were analyzed using the Geostatistical Population Estimator (GSPE) (Ver Hoef 2001). Survey techniques were modified from those outlined by Gasaway et al. (1986). An important change from the Gasaway methodology was, instead of geographical land characteristics, a grid system based on latitude and longitude coordinates was used to locate sample units (~ 5.7 mi^2 in size), with search intensity of ~6 min/mi^2.

Hunter harvest was monitored through moose harvest reports and a moose hunter checkstation operated on the lower Koyukuk River. We encouraged local residents to increase their harvest reporting by providing information at public meetings, checkstations, and village meetings. Hunting mortality and harvest distribution were also monitored through the statewide harvest ticket system, registration harvest tickets, and door-to-door subsistence surveys. General season hunters were sent 1 reminder letter to return their harvest reports. Hunters of permit hunts (drawing, registration, and Tier II hunts) were sent 1 reminder postcard, then called via telephone, and then sent a certified letter. Their names were withdrawn from the following year's permit hunts if no response was received. Information obtained from the reports and surveys was used to determine total harvest, harvest location, hunter residency and success, harvest

chronology, and transportation used. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY99 = 1 Jul 1999–30 Jun 2000).

Predation was evaluated by interviewing trappers, field observations, and aerial wolf reconnaissance surveys in cooperation with the US Fish and Wildlife Service.

No habitat assessment work was conducted during this reporting period.

We continued the intensive planning process implemented in 1998 to address concerns over increasing numbers of hunters in the Koyukuk River drainage. The planning process was initiated in winter 1999–2000, and a Koyukuk River Moose Hunters' Working Group (KWG) was formed with representatives from the state's advisory committees, the federal Western Interior Regional Advisory Council, and local commercial hunting guides. The planning group developed a draft 5-year Koyukuk River Moose Management Plan (ADF&G files) that was submitted to the Alaska Board of Game during their March 2000 meeting. The finalized plan was used as a guide for management goals, objectives, activities, and biological decision-making criteria in this management report, and was endorsed by the Alaska Board of Game at their winter 2001 meeting.

An additional outcome of the KWG was the development of 2 moose management zones within the Koyukuk River drainage (Fig 1). Management zones were established to allow analysis of data and application of management strategies in the 2 areas of the drainage where moose densities, distribution, and harvest patterns were substantially different. The boundary between the 2 units was defined according to uniform coding units. Uniform coding units are statistical reporting areas used for data analysis in the statewide harvest reporting system. Management Zone 1 was a high-density moose area, with moose concentrated heavily along the river corridor. Hunter use in this zone was very high and increasing rapidly over the past 10 years. Management Zone 2 was mostly a low-density moose area, with moose broadly dispersed throughout. Hunter use in this zone was low but has increased some in recent years.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Status and trends of the moose population in an area as large and diverse as Unit 24 are difficult to determine with any degree of certainty. Most often, population size is described using generalities, and trends are discernible only for the few areas surveyed.

During RY99–RY00, moose were numerous in the Koyukuk River lowlands in the southern third of the unit (south of Hughes). Based on recruitment parameters, the population probably declined in the Dulbi Slough, Huslia River Flats, and Treat Island areas (Tables 1–3). Moose densities often exceeded 5 moose/mi^2 in these areas. Further up river, in the Batza Slough and Mathews Slough TCAs, moose densities were 1.9 and 0.3 moose/mi^2, respectively (Tables 4 and 5), with no clear trend.

Moose densities were relatively low in the middle third of the unit (Hughes to Bettles, including the Kanuti CUA and the South Fork Koyukuk River drainage). Apparently, this portion of the population declined during the 1990s.

Population Size

In the previous reporting period, there were 5000–7000 moose in the southern portion of Unit 24. This estimate was based on the results of 1987 and 1997 population estimation surveys (Huntington 1998) and on extrapolations of density estimates obtained during trend count surveys (Woolington 1998). Additionally, there were 3000–4000 moose in the middle portion of Unit 24. This estimate was based on population estimation surveys of the Kanuti National Wildlife Refuge in 1989 and 1993 (Table 6) and the Dalton Highway Corridor in 1991 (Martin and Zirkle 1996). These surveys indicated a rather low overall early winter density of 0.42–0.76 moose/mi^2 (Woolington 1998).

There were an estimated 3000–4150 moose in the northern portion of Unit 24, including 1500–2000 moose within the Gates of the Arctic National Park. This estimate was based on the distribution of moose seen during a 1987 stratification survey, and a density estimate of 0.42 moose/mi^2 completed by Dale et al. (1995). Dale et al.'s estimate was based on 1990 data collected during their wolf predation study in the Alatna River drainage within Gates of the Arctic National Park.

I estimated there were 9000 moose ±1500 (7500–10,500) in Unit 24 in fall 1999 (Table 7). My estimate was based on our 1999 GSPE survey in 8390 mi^2 of the Upper Koyukuk drainage, and on Woolington's (1998) data. Separate estimates were made for Management Zone 1 and for Management Zone 2 to facilitate planning discussions with the KWG (Fig 1). With recent declines, I estimate the population of the Unit 24 portion of Management Zone 1 was down to 3650 moose, and the population of Management Zone 2 was 4450 for a total population of 8100 moose ±1350 (6750–9450). The estimated declines were based on a 4.5% annual decline in Zone 1 and a 6.0% annual decline in Zone 2.

Population Composition

Composition data were available from aerial surveys conducted in cooperation with US Fish and Wildlife Service staff from the Koyukuk National Wildlife Refuge and Kanuti National Wildlife Refuge (Tables 1–5). Results from surveys conducted in RY99 were variable. Bull:cow ratios were high, as in previous years, in the Batza Slough and Huslia River Flats TCAs and on the Kanuti Refuge. However, the Dulbi Slough, Treat Island, and Mathews Slough bull:cow ratios declined substantially. Franzmann and Schwartz (1998) suggested a ratio of 20–30 bulls:100 cows is needed to ensure breeding of all available cows. Calf:cow ratios for the RY99 Mathews Slough TCA were unreliable due to small sample size.

Distribution and Movements

There is little data available on movements of moose within the unit. Thirteen moose radiocollared in winter 1984–1985 in northern Unit 21D migrated into the southwestern parts of Unit 24 during each summer. Generally, moose are found at treeline in the northern part of Unit 24 during early winter and move into the river bottoms during late winter and summer.

MORTALITY

Harvest

Season and Bag Limit.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 24, that portion within the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 moose per regulatory year, only as follows:		
1 moose by registration permit only; or	27 Aug–31Aug (Subsistence hunt only)	
1 bull by registration permit only; or	1 Sep–20 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Unit 21(D) that portion within the Koyukuk Controlled Use Area; or	5 Sep–25 Sep (Subsistence hunt only)	
1 moose.	1 Dec–10 Dec 1 Mar–10 Mar (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side by drawing permit; up to 80 permits may be issued in combination with Unit 21(D), that portion within the Koyukuk Controlled Use Area.		5 Sep–25 Sep
Unit 24, that portion of the John and Alatna River drainages within the Gates of the Arctic National Park.		
RESIDENT HUNTERS: 1 moose.	1 Aug–31 Dec	
NONRESIDENT HUNTERS:		No open season
Unit 24, all drainages to the north		

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
of the Koyukuk River upstream from the Henshaw Creek drainage, to and including the North Fork of the Koyukuk River, except that portion of the John River drainage within Gates of the Arctic Park.		
RESIDENT HUNTERS: 1 moose; however, antlerless moose may be taken only during the period 21 Sep–25 Sep.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–25 Sep
Unit 24, all drainages to the north of the Koyukuk River between and including the Alatna River and Henshaw Creek drainages, except that portion of the Alatna River drainage within Gates of the Arctic National Park.		
RESIDENT HUNTERS: 1 moose; however, antlerless moose may be taken only during the periods 21 Sep–25 Sep and 1 Mar–10 Mar.	1 Sep–25 Sep 1 Mar–10 Mar	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–25 Sep
Remainder of Unit 24.		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. Subsistence and general registration hunts were established in the Koyukuk CUA downstream of Huslia by the Board of Game in

March 1996. This action was to counter a moose hunting closure by the Federal Subsistence Board. The federal board closed federally managed lands within one-half mile of the Koyukuk River in nearby Unit 21D, from the Kateel River to 40 miles upstream from the mouth of the Koyukuk, for all but local rural residents. This closure was prompted by perceived declines in moose availability for local residents and by an increase in moose hunters. Two separate registration hunts were established. A subsistence registration hunt was opened to all Alaska residents during 1 September–25 September, with a bag limit of 1 moose. All the meat had to remain on the bones, the head had to be salvaged, and the antlers were cut to destroy the trophy value. A general registration hunt was opened to all hunters during 5 September–25 September, with a bag limit of either 1 antlerless moose or 1 bull with antlers at least 50 inches wide, or at least 4 brow tines on at least 1 side. Seasons and bag limits for the remainder of the unit were unchanged.

Moose hunter numbers and moose harvests for RY96 in the lower Koyukuk River area increased in spite of the new hunting regulations. The increase in hunters heightened concerns for the area. The Middle Yukon River Fish and Game Advisory Committee and the Western Interior Regional Advisory Council both petitioned the Board of Game to take up the Koyukuk moose issue at their next meeting even though it was not on the board's schedule. They asked the board to accept proposals, open discussion on moose hunting in the area, and to address the problems associated with increased hunter numbers and increased harvest. In response, the Board of Game allowed ADF&G to modify registration hunt requirements. The general registration hunt within Unit 24 was restricted to that portion of the Koyukuk River downstream from and including Dulbi Slough. Also, the department limited the number of general registration permits available at any one time to a maximum of 250. In RY99 the department used discretionary authority to further limit the number of available permits to 215, which also proved to be ineffective at limiting hunter participation. Similar modifications of the registration hunt requirement also occurred in nearby Unit 21D.

Several changes were made to the regulations during the 2000 and 2002 Board of Game meetings, due mostly to recommendations proposed by the KWG. Foremost among the changes was implementation of limited drawing hunts for the Koyukuk Controlled Use Area in RY00 and for the Dalton Highway Corridor Management Area in RY02. In RY00 the antlerless moose season for the general season drawing hunts, formerly RM830, was closed, and the antlerless season for the subsistence registration hunt RM832 was reduced to the first 5 days of the season. The RM832 hunt was also shifted forward 5 days so it opened on 27 August and closed on 20 September. Additional restrictions applied by department discretionary authority required hunters to saw through the middle of the palm of one of the antlers of bulls harvested under a RM832 permit. In RY00 and RY01 an Emergency Order closed the March season in the area north of the Koyukuk River between the Alatna and North Fork Rivers. Unexpected increases in hunter participation made it necessary to close that season early because of the excessive harvest of the relatively low number of moose in that area, especially in the lower portion of the Wild River drainage.

Hunter Harvest. Hunting seasons in the unit were diverse and reflected various moose densities and consumptive use patterns. Annual reported harvest during RY88–RY01 averaged 167 moose (123–240, Table 8).

Illegal and unreported harvests by local residents continued to hamper department efforts to manage moose. During some years, actual harvest was estimated to be about twice the reported harvest (Table 8). Moose taken during winter were rarely reported, even when the season was open. Several villages have never had a license vendor. This contributed to the problem of hunters hunting without licenses or harvest tickets.

Harvest Chronology. Over 95% of reported harvest occurred in the September seasons (Table 9). However, much of the unreported harvest likely occurred during October–March (Anderson et al. 1998).

Permit Hunts. In RY00 the drawing permit hunts replaced the general registration permit RM830. Beginning in RY00 either subsistence registration permit RM832 or one of the limited drawing permits (DM827, 828, 829, or 830) were required in the fall in the Koyukuk CUA. The number of permits issued for RY00 was 16.7% less than RY99, the last year of registration permit RM830 (Table 10). Total moose harvested in the 5 KCUA hunts decreased by 25% in RY00 and by another 33% in RY01. However, the decrease in RY01 was likely due primarily to warm weather during September. In fact, the number of RM832 permits issued increased by 48, or 13.5% from RY00. Due to concerns over the declining number of moose in the KCUA, the number of drawing permits issued for RY02 was reduced to 198, down from 258 in the previous 2 years.

Hunter Residency and Success. Based on harvest reports, there was an average of 301 moose hunters during RY91–RY01, the majority of which were Alaska residents (Table 11). The number of hunters was probably underreported because unit residents often did not report unsuccessful hunt information. Harvest and hunter participation by Unit 24 residents was relatively constant, according to Division of Subsistence surveys (Anderson et al. 1998). However, nonresident and nonlocal resident hunter participation increased steadily since RY88. The increase in nonlocal hunters has created tension among user groups and was the impetus for creating the KWG.

The estimated annual harvest by residents of Unit 24 is about 172 moose according to Marcotte (1986) and Marcotte and Haynes (1985). They estimated residents of Huslia, Hughes, Allakaket/Alatna, Bettles, and Wiseman annually took 84, 33, 35, 10, and 5 moose, respectively. An additional 5 moose were probably taken by residents of the unit who did not live in a village. Data reported by Anderson et al. (1998) was similar to earlier results. The estimated unreported harvest incorporated recent Subsistence Division data, less the reported harvest by unit residents (Table 8).

Transportation Methods. In RY99–RY00, boats continued to be the primary transportation method in Unit 24 because of the extensive river system, lack of roads, and restrictions on the use of aircraft within the 2 CUAs (Table 12). Highway vehicles were only used on the Dalton Highway where it crosses the eastern part of the unit. Snowmachines were the main transportation method used during the winter hunt.

The Dalton Highway was closed to the public at the Yukon River Bridge after construction was completed, but was opened to public use throughout Unit 24 in 1981. Number of hunters and

moose harvest for hunters accessing Unit 24 by the Dalton Highway during RY88–RY98 was fairly stable at 78–128 hunters, taking 27–67 moose each year (Table 13).

Other Mortality

A minimum of 400–440 wolves in 55–60 packs and a large population of black bears inhabit the middle and southern portions of the unit. Grizzly bears are common throughout the montane areas. Predation on moose was thought to be high, keeping the moose population low throughout much of the central portion of the unit.

MANAGEMENT PLANNING

The KWG met twice during RY00–RY01, and the Management Plan (ADF&G files) developed by the Working Group was formally endorsed by the Board of Game at their winter 2001 meeting. The plan was the basis for developing goals and activities for moose management in Unit 24. Although the KWG area of concern was specifically within the Koyukuk River drainage, the issues were characteristic of concerns throughout Unit 24 and nearby Unit 21D.

CONCLUSIONS AND RECOMMENDATIONS

Unit 24 is larger than some states, with a wide range of habitats available to moose. Moose densities range from quite high in small portions of the unit to the typical low densities expected at these latitudes. Hunting activity was typically concentrated in areas accessible by boat, with the potential for creating conflicts between local subsistence hunters and nonlocal hunters. Conflicts between user groups, whether real or perceived, have the potential to greatly affect future management decisions.

Habitat was excellent throughout much of the unit, with an abundance of successional willow regrowth due to either fire or riverine erosion. Availability of browse was not limiting the moose population during the report period.

With the exception of limited areas around Allakaket, Bettles, and Huslia, predation on moose by wolves and bears was likely the major factor limiting Unit 24 moose populations. Unit residents met their wild food requirements, but hunting opportunities cannot be expanded for people living outside the unit until moose numbers increase. Where predators have been lightly harvested for long periods, predation seems to keep moose densities low (0.1–1.0 moose/mi^2 in areas >800 mi^2, Gasaway et al. 1992).

We need to obtain population estimates for the Hogatza River drainage and the northern area including Gates of the Arctic National Park. A population estimation survey should be undertaken in cooperation with National Park Service when funding is available. Trend data should also be collected in popular hunting areas such as the South Fork Koyukuk River upstream from the Dalton Highway, the Alatna River, the John River, and the Kanuti River area.

For the first goal concerning harvest within sustained yield principles, my estimated population of 9000 moose did not achieve the objective to maintain a population of 10,000–12,000 moose. We achieved the objective to provide for an adequate moose harvest without exceeding a 5% harvest rate. We also achieved the objective to provide for hunting opportunity that does not

exceed 500 hunters. For the second goal relating to habitat, activities were limited to the review of burn plans but no enhancement projects were implemented. The objective of the third goal, to reduce meat spoilage, was not evaluated during the reporting period. Subjectively, regulations appear to have heightened awareness about proper meat care, but objective measures were not developed to evaluate whether this objective was met. This was also the case for the objective of the fourth goal to increase nonconsumptive activities. Measures will be developed in the next reporting period to begin evaluating these parameters.

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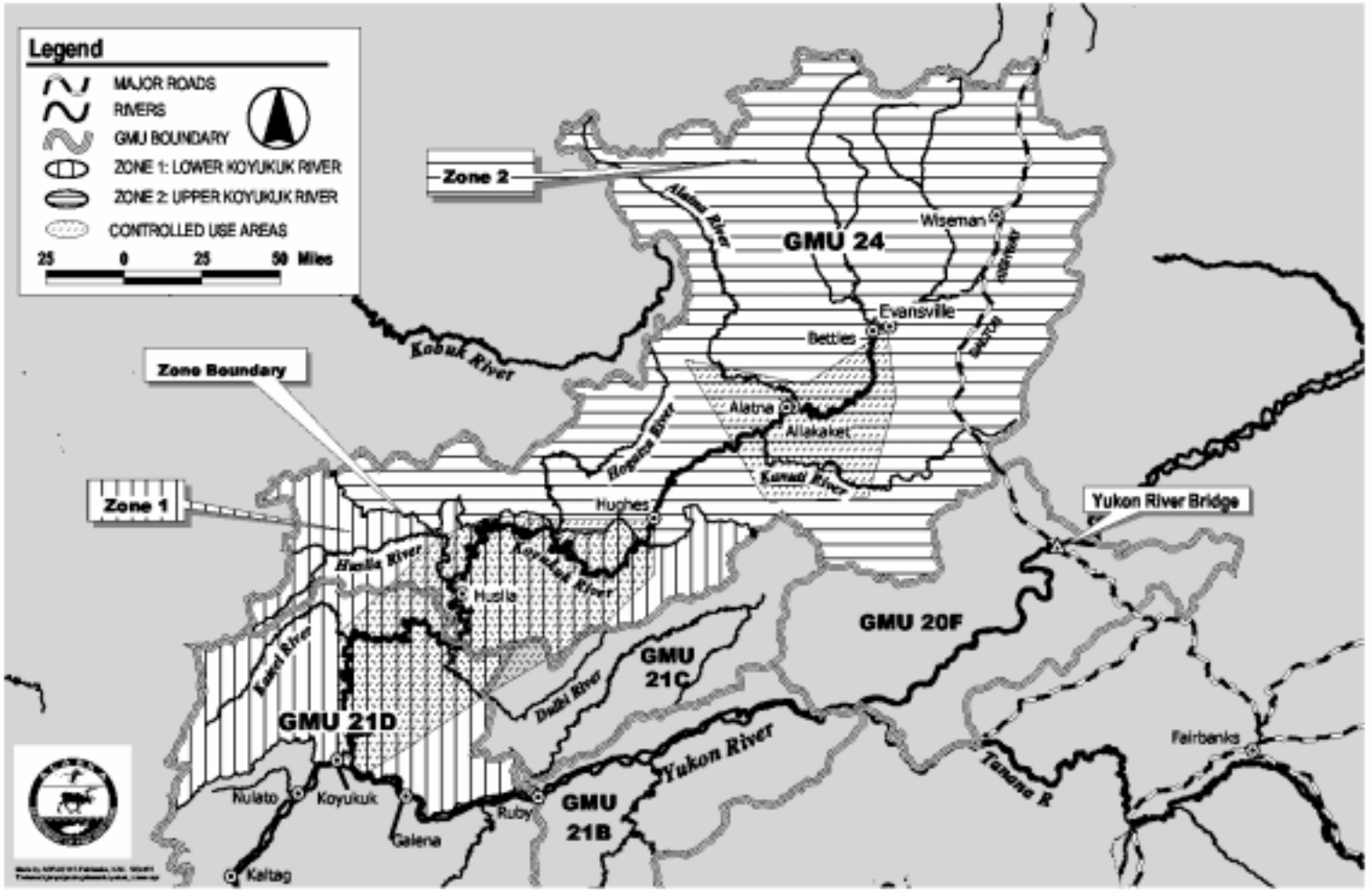

Figure 1 Units 21D and 24 management zones developed by the Koyukuk River Moose Hunters' Working Group

Table 1 Unit 24 Dulbi Slough aerial moose composition counts, regulatory years 1982–1983 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1982–1983	35.0	45	5	7	0	4.5	111	3.2
1983–1984	39.0	17	8	33	14	22.5	113	2.9
1984–1985	48.1	19	8	20	6	14.6	130	2.7
1985–1986	54.2	19	9	10	0	7.7	170	3.1
1989–1990	48.7	53	7	23	18	13.1	298	6.1
1996–1997	86.4	24	8	37	1	23.0	443	5.1
1999–2000	89.0	11	3	22	5	16.1	411	4.6
2001–2002	89.0	18	7	25	0	17.4	327	3.6

Table 2 Unit 24 Huslia River Flats aerial moose composition counts, regulatory years 1983–1984 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1983–1984	80.0	36	7	23	3	14.6	212	2.7
1985–1986	64.5	45	17	10	25	6.7	254	3.9
1989–1990	38.2	50	2	30	7	16.7	90	2.4
1993–1994	80.2	81	15	24	8	11.8	483	6.0
1997–1998	80.2	58	15	24	9	13.2	438	5.5
2000–2001	80.2	35	3	17	4	11.2	259	3.2
2001–2002	80.2	44	7	14	0	8.7	378	4.7

Table 3 Unit 24 Treat Island aerial moose composition counts, regulatory years 1985–1986 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1985–1986	41.0	35	13	17	5	10.9	192	4.7
1993–1994	40.3	39	11	25	7	15.1	317	7.9
1998–1999	67.1	25	6	19	2	13.5	379	5.7
1999–2000	67.1	21	5	15	11	10.8	279	3.6
2000–2001	67.1	16	4	13	5	10.0	430	5.6
2001–2002	67.1	32	4	12	4	8.4	321	4.3

Table 4 Unit 24 Batza Slough aerial moose composition counts, regulatory years 1986–1987 through 1999–2000

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1986–1987	52.9	39	2	11	0	7.6	66	1.3
1997–1998	46.5	51	2	21	0	12.2	74	1.6
1998–1999	46.5	76	12	17	0	8.9	79	1.7
1999–2000	46.5	60	6	12	12	7.0	86	1.9

Table 5 Unit 24 Mathews Slough aerial moose composition counts, regulatory years 1983–1984 through 1999–2000

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1983–1984	51.8	85	19	15	0	7.4	54	1.0
1997–1998	61.9	60	7	7	0	4.0	25	0.4
1998–1999	61.9	69	16	22	0	11.5	61	1.0
1999–2000	50.8	15	0	8	0	5.9	17	0.3

Table 6 Unit 24 Kanuti National Wildlife Refuge population estimation surveys, regulatory years 1989–1990 through 1999–2000

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1989–1990[a]	2615	64	4.1	16.5	n/a	9.2	1172 (878–1467)	0.45
1993–1994[a]	2644	61	8.0	33.0	n/a	17.0	2010 (1716–2304)	0.76
1999–2000	2714	61	4.3	27.8	n/a	14.7	1188 (879–1497)	0.39

[a] Martin and Zirkle 1996.

Table 7 Unit 24 population estimation survey summaries, regulatory years 1989–1990 through 1999–2000 (Stout 2000)

Survey area	Area mi^2	Total sample units	Bulls:100 Cows	Calves:100 Cows	Population estimate
Management Zone 1 - **Subtotal**	4696				4000 ± 500
Management Zone 2					
1999 Survey block	8390	1585	65:100	28:100	3036 ± 647 (90% CI)
Moose habitat Unit 24/North[a]	4752		65:100	28:100	1720 ± 353
Remainder Unit 24/North[b]	8217		65:100	28:100	244 ± 50
Subtotal	21,359				5000 ± 1050
Unit 24 – **Total**	26,055				9000 ± 1500

[a] The estimated area of Unit 24 that could potentially support moose year-round.
[b] The area remaining in Unit 24 with very little year-round moose habitat, primarily the high altitude mountainous portion within Gates of the Arctic National Park.

Table 8 Unit 24 moose hunter harvest, regulatory years 1988–1989 through 2001–2002

Regulatory	Harvest by hunters				Unreported	
Year	Bull	Cow	Unk	Total	harvest	Total
1988–1989	132	5	0	137	131	268
1989–1990	119	8	1	128	132	260
1990–1991	141	2	1	144	129	273
1991–1992	141	2	1	144	129	273
1992–1993	118	5	0	123	124	247
1993–1994	139	12	0	151	116	267
1994–1995	134	8	0	142	135	277
1995–1996	161	8	0	169	129	298
1996–1997	176	14	0	190	117	307
1997–1998	168	10	2	180	100	280
1998–1999	213	17	0	230	100	330
1999–2000	228	10	2	240	100	340
2000–2001	211	7	1	219	100	319
2001–2002[a]	134	4	0	138	100	238

[a] Preliminary data.

Table 9 Unit 24 moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2001–2002

Regulatory	Harvest chronology percent by month/day				
year	9/1–9/14	9/15–9/25	12/1–12/10	3/1–3/10	*n*
1996–1997	48	46	2	5	187
1997–1998	49	46	1	4	170
1998–1999	49	47	0	5	219
1999–2000	43	52	0	4	231
2000–2001	46	49	0	4	205
2001–2002[a]	34	62	2	2	133

[a] Preliminary data.

Table 10 Units 21D and 24 Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 1998–1999 through 2001–2002

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Unk	Total harvest
RM832	1998–1999	295	0	45	55	125	77	38	23	0	163
	1999–2000	356	0	49	51	127	70	54	30	1	182
	2000–2001	355	8	44	48	157	93	11	7	1	169
	2001–2002[a]	403	8	60	32	126	97	3	2	1	130
RM830[b]	1998–1999	330	0	45	55	159	87	23	13	0	182
	1999–2000	380	0	51	49	148	79	39	21	0	187
DM827	2000–2001	26	15	42	38	10	100	0	0	0	10
	2001–2002[a]	26	19	50	23	5	83	1	7	0	6
DM828	2000–2001	103	51	11	37	38	100	0	0	0	38
	2001–2002[a]	103	63	19	17	17	100	0	0	0	17
DM829	2000–2001	26	15	23	62	16	100	0	0	0	16
	2001–2002[a]	26	15	31	31	8	100	0	0	0	8
DM830	2000–2001	103	41	15	44	45	100	0	0	0	45
	2001–2002[a]	103	51	19	25	26	100	0	0	0	26
Total	1998–1999	625	0	45	55	284	82	61	18	0	345
	1999–2000	736	0	50	50	275	75	93	25	1	369
	2000–2001	613	22	28	45	11	96	11	4	1	278
	2001–2002[a]	661	24	41	28	4	97	4	2	1	187

[a] Preliminary data.
[b] RM830 ended in RY00 and was replaced by Drawing Hunts DM827, 828, 829, and 830.

Table 11 Unit 24 moose hunter residency and success, regulatory years 1988–1989 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	
1988–1989	41	57	16	23	137	13	63	18	25	119	256
1989–1990	40	68	17	3	140	28	107	16	4	155	283
1990–1991	43	71	22	8	144	17	81	16	9	123	267
1991–1992	43	77	23	1	144	14	138	16	3	171	315
1992–1993	48	62	7	6	123	27	129	27	3	186	309
1993–1994	56	68	25	2	151	24	94	23	1	142	293
1994–1995	37	78	25	2	142	10	90	21	3	124	266
1995–1996	43	97	30	0	170	12	93	18	0	123	293
1996–1997	55	95	38	2	190	24	98	26	0	148	338
1997–1998	40	97	41	2	180	18	81	20	0	119	299
1998–1999	41	125	59	5	230	20	120	25	2	167	397
1999–2000	40	119	77	4	240	25	143	39	3	210	450
2000–2001	57	124	38	1	220	36	141	55	0	232	452
2001–2002[b]	30	100	47	2	179	18	172	56	3	249	428

[a] Unit resident only.
[b] Preliminary data.

Table 12 Unit 24 moose harvest percent by transport method, regulatory years 1988–1989 through 2001–2002

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1988–1989	23	1	49	1	0	3	13	9	137
1989–1990	19	1	44	1	1	1	24	9	140
1990–1991	16	3	56	3	1	2	16	3	144
1991–1992	25	2	44	3	1	2	17	5	144
1992–1993	16	0	56	3	5	1	13	6	123
1993–1994	15	0	60	6	5	2	7	4	151
1994–1995	17	2	53	3	5	3	12	4	142
1995–1996	13	2	59	2	6	2	15	2	170
1996–1997	12	1	62	3	6	1	13	4	190
1997–1998	19	1	51	7	6	1	11	6	178
1998–1999	17	0	62	2	4	0	10	5	230
1999–2000	17	1	56	3	4	0	18	1	240
2000–2001	16	0	61	3	4	1	14	2	220
2001–2002[a]	18	1	62	2	3	0	15	1	179

[a] Preliminary results.

Table 13 Unit 24 moose harvest by hunters using the Dalton Highway for access, regulatory years 1988–1989 through 1996–1997

Regulatory year	Dalton Highway hunters	
	Successful	Unsuccessful
1988–1989	50	44
1989–1990	57	35
1990–1991	67	61
1991–1992	55	33
1992–1993	27	100
1993–1994	36	61
1994–1995	60	42
1995–1996	41	37
1996–1997	43	55

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNITS: 25A, 25B, and 25D (47,968 mi^2)

GEOGRAPHIC DESCRIPTION: Upper Yukon River Valley

BACKGROUND

Historically, moose have been relatively scarce in the upper Yukon River valley. Long-time residents of the area report moose were hard to find in the early 1900s, but were more common in recent years (F Thomas, H Petersen, K Peter, personal communication). However, moose density continues to be low compared with many other areas in Interior Alaska. A few population surveys were done in the late 1970s, and more extensive surveys began in 1981 when the Alaska Department of Fish and Game (ADF&G) established a Fort Yukon area office. Estimates of population density in survey areas on the Yukon Flats in Unit 25D have ranged from a low of 0.1 moose/mi^2 in the west in 1984 to 0.64 moose/mi^2 in the east in 1989 (ADF&G files). Extrapolations from trend surveys and stratification efforts resulted in estimates of 1253 moose in 1984 and 2000 moose in 1989 in a 5400-mi^2 area in Unit 25D East (Maclean and Golden 1991). Survey techniques have been modified to reflect advances in sampling techniques and to accommodate the area's relatively low moose density.

Population surveys and observations by local residents suggest that moose numbers increased somewhat during the 1970s and 1980s in Unit 25D. Trend counts and population estimates, as well as anecdotal information, indicate moose numbers were stable or declining in Unit 25D West and declining in Unit 25D East during the 1990s. Numbers currently appear to be declining in both areas, although the decline is greatest in Unit 25D East. Moose densities continue to be low compared to other areas in Alaska, making it difficult to simplify regulations.

Recent population trends in Units 25A and 25B are not well understood. Composition surveys were last conducted in Unit 25B in 1987. Reports from experienced guides and pilots indicate moose numbers in Unit 25B declined in recent years and are currently at a low level. Population surveys in Unit 25A suggest that numbers have declined during the last decade.

Based on knowledge of wolf numbers and food habits and moose mortality studies, limiting factors include predation by black bears, grizzly bears and wolves, as well as hunting. A recent moose calf mortality study showed that predation by black bears and grizzly bears is the major cause of calf moose mortality during summer (US Fish and Wildlife Service, unpublished data).

During 1999 and 2000, 30 radiocollared cows and their calves were monitored over a 2-year period in Unit 25D West. The results showed that only about 20% of calves born survived until 30 November. Major sources of mortality included black bears (45%), brown bears (39%), wolves (3%), drowning (8%) and abandonment (5%). Average annual survival of adult cows averaged 88%. In the first year, 2 cows were killed by brown bears and 1 was killed illegally by a hunter. Four were killed by wolves during the second year. The pregnancy rate was 89%, and 63% of the cows had twins. Vegetation surveys indicate that moose browse is abundant and browsing intensity is low (ADF&G, unpublished data; C Fleener, personal communication). The area is characterized by low to moderate snowfall.

Unit 25D was divided into Units 25D West and 25D East during the early 1980s to allow the use of regulatory schemes that reflected the different status of moose populations. The boundary between the 2 areas lies along Preacher and Birch Creeks south of the Yukon River and along the Hadweenzic River north of the Yukon. Low moose density in Unit 25D West, combined with the relatively high demand for moose by local residents, resulted in the use of permit systems that limited hunting largely to residents of the area.

A registration permit hunt was established in Unit 25D West in 1983, with a bag limit of 1 bull and a 25 August–5 October open season. Sixty permits were issued to residents of the 3 communities in the area. The fall season was shortened and 2 winter hunting periods were added in 1984. A harvest quota of 35 bull moose was established in 1986. A Tier II permit hunt was established in regulatory year (RY) 1990–1991 because the harvestable surplus was deemed insufficient to support all subsistence uses, and restrictions were thought to be necessary (RY = 1 Jul–30 Jun, e.g., RY90 = 1 Jul 1990–30 Jun 1991).

A harvest quota of 35 bull moose was established in Unit 25D West in 1986. Since 1990, moose have been hunted under a Tier II permit system with up to 125 Tier II permits issued each year. In 1990 the Federal Subsistence Board promulgated regulations for subsistence use on federal lands. These regulations took effect 1 July 1991, when a federal subsistence moose permit system was established in Unit 25D West. It provided an unlimited number of permits to residents of the 3 communities in Unit 25D West to hunt bull moose on federal lands. The state Tier II permit system remained in effect and applied to both private and federal lands. A maximum of 30 federal permits and 125 state Tier II permits were issued each year beginning in 1993. In 1993 there also was a change in the way regulations were applied in Unit 25D West. Federal permits were required on federal land and were issued only to residents of the 3 communities in the unit. However, state Tier II permits issued to residents of Unit 25D West were again recognized as valid on federal lands beginning in 2000, when 60 federal and 75 state Tier II permits were available, with a harvest quota of up to 60 bull moose.

Dual management also affected regulations in Units 25A, 25B, and 25D East. Seasons for eligible local residents hunting on federal land were longer (generally 25 Aug–25 Sep and 1 Dec–20 Dec) than the state season. The state season applied to all hunters on private and state lands and to nonlocal hunters on federal lands.

The cumulative effect of various annual permit application requirements, confusion over geographic boundaries, and other circumstances have resulted in low reporting and limited participation in the harvest management system. Discussions with local residents during 1999

helped identify a number of steps that could improve moose management on the western Yukon Flats. They included revising the harvest quota for moose, reducing the maximum number of Tier II permits available, and aligning state and federal hunting seasons.

In early 2001 the department initiated a cooperative effort to develop a moose management plan for the Yukon Flats. The plan was developed under the sponsorship of the Alaska Department of Fish and Game, Division of Wildlife Conservation, in cooperation with the Yukon Flats Fish and Game Advisory Committee (YFAC), through the Yukon Flats Moose Management Planning Committee. Other stakeholders involved in the project include the Council of Athabascan Tribal Governments, individual tribal governments, the Yukon Flats National Wildlife Refuge, the US Fish and Wildlife Service (FWS) Office of Subsistence Management and other interested users of the Yukon Flats moose resource. The Yukon Flats Moose Management Planning Team was established through consultation with the YFAC, local communities and other interests. The planning effort employed an extensive public consultation process, with local communities playing a key role in developing a plan to enhance moose numbers. Some of the key issues that were addressed include reducing predation on calf and adult moose, reducing the harvest of cow moose, and improving harvest reporting.

A study of local opinions on moose management issues in Fort Yukon during 1995–1996 indicated there was substantial concern about the status of moose populations, opposition to the taking of cow moose, and support for increased enforcement, biological studies, predator control and local involvement in moose management (C Fleener, unpublished report). The current moose management planning effort focused public concerns about moose management in local communities as well as among nonlocal hunters and other interested parties. The Yukon Flats Moose Management Plan was designed to promote increasing the Yukon Flats moose population in the following ways: 1) Improve moose harvest reporting to better document subsistence needs and improve management; 2) Reduce predation on moose by increasing the harvest of bears and wolves; 3) Minimize illegal cow moose harvest and reduce harvest of cows for ceremonial purposes so that more calves are born; 4) Inform hunters and others about the low moose population on the Yukon Flats and ways people can help in the effort to increase moose numbers; 5) Use both scientific information and traditional knowledge to help make wise management decisions.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

Unit 25 Overall

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.

Unit 25A

- Provide an opportunity to hunt under aesthetically pleasing conditions and provide for subsistence use.

Units 25B and 25D

- Provide for subsistence use and for the greatest opportunity to harvest moose.

MANAGEMENT OBJECTIVES

Unit 25 Overall

- Continue efforts to communicate with and educate local residents about moose management and the effects of cow moose harvest.
- Monitor moose population status through annual surveys.
- Work with natural resource offices in local communities to obtain and exchange information on moose populations and management issues, develop a moose management plan, and improve harvest reporting.

METHODS

A moose population survey (Gasaway et al. 1986) was conducted in November 1992 in Unit 25D West using multiple PA-18 aircraft and a C-185 for stratification. Population surveys using similar techniques, including regression analysis (J Ver Hoef, ADF&G, personal communication), were conducted in Unit 25D West in fall 1996, spring 1999, and fall 1999, 2000, and 2001 and in Unit 25D East in fall 1995, 1997, 1999, 2000 and 2001. Ninety-percent confidence intervals were calculated for most estimates. Beginning in 1999, population surveys were conducted using a spatial analysis technique, referred to as the Geostatistical Population Estimator (GSPE), recently developed by Ver Hoef (2001). Survey areas were stratified according to moose density using C-185 or C-206 aircraft. Randomly selected sample units were counted with PA-18 or Scout aircraft flown about 500 feet above ground level at 70 miles per hour. We circled moose to determine sex, age, and antler size of bulls, and to locate other moose. Moose habitat in established count areas or sample units was searched systematically at an intensity of at least 4 minutes/mi^2. Sex and age composition observed during trend surveys is presented, as well as observed and estimated sex and age composition based on data collected during population surveys. Population sex and age composition were estimated using statistical and spatial analyses based on bull:cow, calf:cow, and yearling bull:cow ratios observed in different density strata and the area extent of each strata (Ver Hoef 2001). Population surveys in Unit 25A involve counting discrete survey areas that encompass the major moose habitat in a large area in the eastern part of the unit.

Harvest reports provided information on hunter effort, residency, success, transportation, and antler size. Harvest data were summarized by regulatory year. Informal visits and interviews with area residents provided additional insight into hunter effort and concerns about moose management issues.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Units 25A and 25B. A population survey was completed in eastern Unit 25A in fall 2000 (Arctic National Wildlife Refuge, unpublished data). The survey area was identical to that used in 1989 and 1991 and survey conditions were excellent. The number of moose observed was about 50% lower than in the 1989 and 1991 surveys, suggesting that moose numbers declined during the last decade (Table 1). Reports from some knowledgeable observers indicate moose numbers in

southern Unit 25A also declined during this period. No population surveys were completed in Unit 25B during RY99–RY02. Reports from hunters in Unit 25B indicate that moose have declined south of the Porcupine River and in the upper Black River drainage, and are also relatively scarce north of the Porcupine River. Surveys in Yukon–Charley Rivers National Preserve in the southern part of Unit 25B resulted in estimated densities of 0.34 moose/mi^2 in 1994 and 0.23 moose/mi^2 in 1997 and 1999 (Burch 1999).

Unit 25D East. A population survey in Unit 25D East in 1995 resulted in an estimate of 704 moose (±33%) in a 1534-mi^2 area (0.46 moose/mi^2) encompassing important hunting areas near Fort Yukon (Table 2). Estimated moose density varied considerably among 3 subunits in the sample area, ranging from 0.12 moose/mi^2 around Fort Yukon to 0.75 moose/mi^2 in the Graveyard Lakes area. A similar survey in 1997 resulted in an estimate of 625 moose (±36%) and a density of 0.40 moose/mi^2. In fall 1999 the moose population in a 2936-mi^2 survey area was estimated at 829 (±20%) with an overall density of 0.28 moose/mi^2. A fall 2000 survey resulted in an estimate of 726 (±25%). The survey area used beginning in 1999 encompassed the smaller area used in 1995 and 1997. The lower density probably reflected both a decline in numbers and the addition of primarily low-density habitat to create the expanded survey area.

The fall 2001 population survey in the 2936-mi^2 area resulted in an estimate at 514 ± 27%. This is lower than 1999 and 2000 estimates. Estimated density in high and low strata was 0.37 and 0.03 moose/mi^2, respectively, with an overall density of 0.18 moose/mi^2 (Table 2). We also calculated a population estimate based on data from sample units representing the area surveyed in 1995 and 1997. This resulted in an estimate of 305 ± 32% moose (0.20/mi^2) in the 1550-mi^2 area. This compares to the 1999 and 2000 estimates of 516 ± 20% and 385 ± 26% and 1995 and 1997 estimates of 704 ± 33% (0.46/mi^2) and 625 ± 36%. These estimates suggest population density has declined from about 0.40 moose/mi^2 in 1995 to 0.20/mi^2 in 2001. Limited snow cover and reduced sightability may have contributed to the relatively low estimate in 2001.

The total population in Unit 25D East in 1999 was probably 2000–3000 moose, assuming the population densities estimated in the 1999 survey area (0.13 moose/mi^2 in low strata and 0.28 moose/mi^2 overall) represent the upper and lower limits of moose density in the remaining 8000 mi^2 outside the survey area. Subsequent surveys indicate the total population is nearer the lower end of this range.

The apparent downward trend in moose numbers in Unit 25D East probably reflects relatively high adult mortality from predation by wolves and grizzly bears, high hunter harvests and continued predation by bears on moose calves. Many local residents have observed a decline in moose numbers during the last decade. The population has the potential to increase if cow and calf mortality can be reduced.

Unit 25D West. In 1992 a population survey indicated there were an estimated 602 moose (± 22%) in 4544 mi^2 of Unit 25D West (Table 2). Density was 0.12 moose/mi^2. In 1996 we estimated a density of 0.44 moose/mi^2 in a 1531-mi^2 portion of the subunit. The survey area established in 1996 encompassed much of the high quality moose habitat in the subunit. Poor survey conditions in fall 1998 precluded surveys, but a survey was conducted in Unit 25D West in March 1999. This survey marked a transition to the recently developed spatial analysis survey (GSPE) technique, and employed a somewhat larger survey area that encompassed the previous

area. The March survey resulted in an estimate of 735 ± 17%, or 0.32 moose/mi^2, in the 2269-mi^2 survey area. A fall 1999 survey in the same area resulted in a population estimate of 862 ± 19%, with a density of 0.38 moose/mi^2 (Bertram and Vivion 1999). Data gathered in the part of the area that had been surveyed in 1996 were used to generate an estimate of 0.40 moose/mi^2, which compares to the 1996 estimate of 0.44 moose/mi^2. A fall 2000 survey resulted in an estimate of 670 ± 24% moose in the 2269 mi^2 area, and 555 ± 24% in the original 1774 mi^2 area, suggesting the population was lower than in previous years. A fall 2001 survey yielded an estimate of 668 ± 24% in the 2269-mi^2 area, and 543 ± 25% in the 1774-mi^2 survey area, indicating little change in numbers compared to the previous year.

Moose population density in Units 25D East and 25D West continued to be low relative to habitat potential, but it appears that recent population trends and composition may differ between the 2 areas. Survey data suggest moose numbers have declined since 1995 in both Unit 25D East and Unit 25D West, with the steepest decline on the eastern flats. These trends may be related to differences in the level of harvest as well as other factors. Recent harvest surveys indicate that approximately 150–200 moose are harvested in Unit 25D East each year, while about 60 moose are taken in Unit 25D West. Assuming prehunt populations of at least 2500 moose in the east and 1700 in the west, this suggests harvest rates on the order of 6–8% in Unit 25D East and 3–4% in Unit 25D West.

Population Composition

Units 25A and 25B. Trend surveys conducted by FWS in Unit 25A in 1987, 1989, 1991, and 2000 showed high bull:cow ratios (63–91:100) and moderate calf and yearling survival (Table 1). Moderate to low harvests related to logistic limitations suggest that hunting has so far had a minor effect on bull:cow ratios. Surveys have not been conducted in northern Unit 25B in recent years, but surveys in Yukon–Charley Rivers National Preserve indicate calf:cow ratios of 36:100 and bull:cow ratios of 51:100 (Burch 1999).

Unit 25D East. Population parameters in Unit 25D East were calculated based on both estimates (Table 3) and observations (Table 4). Fall calf survival was relatively high in 1999, 2000 and 2001, with estimated calf:cow ratios of 59:100, 49:100, and 43:100. The estimated proportion of calves during these years was 27%, 21%, and 18%. We observed 30 cows with single calves and 8 (21%) with twins in 1999, 25 with single calves and 3 (12%) with twins in 2000, and 24 with single calves and 1 (4%) with twins in 2001. The estimated proportion of calves has ranged from 7% in 1997 to 27% in 1999. Low calf survival in 1997 was most likely caused by flooding adjacent to the Black River following almost 6 inches of rainfall during 9–15 June. The estimated proportion of calves in the population is likely higher than the proportion observed because there is usually a higher calf:cow ratio in low density habitat, which includes a large area compared to high density areas.

Calf and yearling survival rates were fairly high during 1998, 1999, 2000, and 2001. However, the decline in total population size indicates the absolute number of young moose also declined. The number of bulls, cows, and total adults generally declined during 1996–2001. The decline in the total number of cows and calves was relatively great and accounts for a large part of the reduction in total numbers that appears to have occurred over the last several years (Table 3).

The number of bulls in the population appears to have declined to a lesser degree, accounting in part for the increase in the bull:cow ratio over the last several years.

Composition data indicate a relatively high bull:cow ratio, with estimated ratios of 57:100 in 1999, 79:100 in 2000, and 95:100 in 2001. Small, medium, and large bulls were well represented in the population. We observed 24, 19 and 20 yearling bulls:100 cows in 1999, 2000, and 2001 (Table 3).

Unit 25D West. Surveys similar to those done in Unit 25D East were completed in Unit 25D West (Tables 3 and 5) (Bertram and Vivion 1999; 2000; 2001). Estimated bull:cow ratios in fall 1999, 2000, and 2001 surveys were 31:100, 71:100, and 52:100. There were an estimated 31 calves:100 cows in 1999, 22:100 in 2000, and 27:100 in 2001. Estimated calf:cow and bull:cow ratios, and the proportion of yearlings were lower in Unit 25D West than in Unit 25D East during 1999–2001 (Table 3).

Distribution and Movements

Moose are distributed throughout the area, but density varies. Large areas currently support densities of 0.1–0.3 moose/mi^2. Somewhat higher densities occur in localized areas in Unit 25D, particularly in late winter when moose tend to concentrate in riparian habitat. Moose also concentrate in relatively small areas during early winter along the upper Sheenjek and Coleen Rivers in Unit 25A, but the extent of these concentrations was limited. Telemetry studies in Units 25D East and Unit 25D West indicate some moose are migratory, moving between higher elevation early winter range and low elevation late winter and summer ranges (Maclean and Golden 1991).

In March 1995 FWS initiated a telemetry study to determine moose seasonal movements and distribution, fidelity to winter range, and relationship between fall moose concentrations and harvest in eastern Unit 25A. Fifty-seven moose (44 females and 13 males) were radiocollared in the Sheenjek, Coleen, and Firth drainages and relocated approximately once each month. A strong pattern of annual movement was evident during the 3-year study, with over 40 moose migrating to the Old Crow Flats in the Yukon during spring and remaining there until late August, when they began moving back into Alaska (Mauer 1998).

Mortality

Harvest

Seasons and Bag Limits.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 25A		
All hunters: 1 bull.	5 Sep–25 Sep	5 Sep–25 Sep

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 25B Porcupine River drainage upstream from the Coleen River drainage: RESIDENT HUNTERS: 1 bull. NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side.	20 Sep–30 Sep	20 Sep–30 Sep
Remainder of Unit 25B RESIDENT HUNTERS: 1 bull; or 1 bull per community harvest report by community harvest permit in an established community harvest area. NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side.	5 Sep–25 Sep 1 Dec–15 Dec	5 Sep–25 Sep
Unit 25D West ALL HUNTERS: 1 bull by Tier II subsistence hunting permit only; up to 75 permits will be issued.	25 Aug–28 Feb	No open season
Unit 25D East Remainder. RESIDENT HUNTERS: 1 bull; or 1 bull per community harvest report by community harvest permit in an established community harvest area. NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side.	10 Sep–20 Sep 18 Feb–28 Feb	10 Sep–20 Sep

Alaska Board of Game Actions and Emergency Orders. In March 2000 the Alaska Board of Game lengthened the state season to 25 August–28 February, aligning it with the season on federal public lands, and agreed with the department's recommendations to increase the harvest guideline from 35 to 60 bull moose and reduce the number of Tier II permits available from 125 to 75. A proposal to include a maximum of 20 cow moose in the harvest quota was not approved by the board. The board also approved a regulation that established a Community Harvest Permit program, under which individual bag limits could be pooled so more than 1 moose could be taken by an individual hunter. The board established the Chalkyitsik Community Harvest Area and a community harvest bag limit for moose in the portion of Units 25D and 25B included in the community harvest area.

The Yukon Flats moose management planning process resulted in a number of regulatory proposals to the Alaska Board of Game. The board reviewed the Draft Yukon Flats Moose Management Plan in March 2002, and addressed proposals relating to moose, wolf, and bear regulations forwarded by the planning team. The board established a 50-inch/4 brow-tine minimum antler size limit for nonresident moose hunters in Unit 25A; changed the moose season from 20 September–30 September to 10 September–25 September season in northern Unit 25B; changed the brown bear season in Unit 25D to 1 March–30 November for residents, and 1 March–15 June and 1 September–30 November for nonresidents; designated Unit 25D as a community harvest hunt area with a community harvest permit hunt and season for black bear; added a 1 August–25 September fall baiting season for black bear; and increased the bag limit for wolf hunting from 5 to 10 wolves in Units 25A, 25B and 25D. The board also endorsed the draft management plan as a framework for managing the Yukon Flats moose population.

Hunter Harvest. The reported number of moose harvested was relatively stable in most of Unit 25 during RY96–RY00 (Tables 6, 7, 8). Reported harvest for Units 25A, 25B, and Unit 25D East was 72 moose in RY99 and 92 in RY00. The reported harvest in connection with the Tier II and federal permit hunts in Unit 25D West was small (Table 9), with 15–30 moose reported taken annually during RY96–RY00. The reporting rate in Unit 25D was generally low, but improved somewhat in Unit 25D West through the use of reminder letters and personal contacts. The actual number of moose harvested in Unit 25D West was not well documented, but reports by local governments, and preliminary results of the Council of Athabascan Tribal Governments (CATG) harvest monitoring study indicate that about 40 bulls and up to 20 cows were harvested each year during RY99–RY00.

Unreported harvest, particularly by local residents, is common in the upper Yukon River valley. Household interviews conducted by the CATG in the communities of Arctic Village, Beaver, Birch Creek, Canyon Village, Circle, Chalkyitsik, Fort Yukon, Rampart, Stevens Village, and Venetie provided relatively complete information on local moose harvest during RY93 and RY94 (CATG, unpublished data). These harvests included 98 and 84 bulls, respectively. A comparison of these data with harvest tickets returned by local residents indicates only 25–35% of the bull moose harvested by local residents in Units 25A, 25B, and 25D East were reported on harvest tickets. Combining the harvest reported by nonlocal residents with the more accurate data for local harvests obtained in the CATG study indicates the total harvest of bull moose in Units 25A, 25B, and 25D East was at least 152 in RY93 and 149 in RY94. A large proportion of the moose harvest in this region occurred in Unit 25D, where the total harvest in recent years appears to have been about 150–200 annually.

Current information indicates that cow moose were taken at any time of year, especially near communities. While the harvest of cow moose seems to have declined somewhat in recent years, it continues to be a concern to many local residents. Two educational videos were produced in 1993 in a cooperative effort between FWS and ADF&G. The adverse effects of shooting cow moose are a central message in each. These videos have been distributed in local communities and other parts of Alaska and Yukon. The need to minimize the harvest of cow moose has also been a major topic of discussion during the development of a moose management plan.

Permit Hunts. Although local residents largely supported the Tier II moose permit hunt in Unit 25D West, there were a number of problems associated with it (Table 9). These included

confusion about differences in applicability of federal and state permits and boundaries of federal and private lands, which are subject to different seasons and/or different permit requirements. These difficulties led to efforts to revise the harvest quota and simplify regulations. The Chalkyitsik Village Council administered a Community Harvest Permit hunt during RY00 and RY01. During RY00, 16 people participated in the hunt, and reported taking 3 bull moose. Twenty-eight people subscribed to the permit during RY01, with a reported harvest of 5 moose.

Hunter Residency and Success. As in previous years, most hunters reporting from Units 25A, 25B, and 25D during RY99–RY00 were Alaska residents (Tables 10, 11, 12). The proportion of nonresidents was greatest in remote parts of Unit 25A, where guiding activity and float trips were more common. Local residents outnumbered other hunters by a wide margin in Unit 25D East. As described above, the number of local moose hunters was underrepresented because of a low reporting rate. Success among reporting hunters was 37–45% in Unit 25A, 41–50% in Unit 25B, and about 25% in Unit 25D East.

Harvest Chronology. Most moose taken in Unit 25 were killed during the first 3 weeks of September, with a few reported killed before and after this period (Tables 13, 14, and 15). A number of moose were also taken in late August during the state Tier II and federal subsistence seasons in Unit 25D West. A few moose were reported taken in the 1–10 December open season, but hunting was almost exclusively by local residents during this period, and the number of moose killed was probably greater than reported. The CATG harvest study indicated that local residents harvested moose throughout the year, with the fewest being taken in spring and early summer and the most in late summer and fall (CATG, unpublished data).

Transport Methods. Aircraft were the most common transport mode in Unit 25A, being used by >50% of the successful hunters. Horses and boats were used in 2–28% of the remaining hunts (Table 16). Boats were used by about 75% of successful hunters in Units 25B and 25D East, with airplanes used in about 10% of successful hunts (Tables 17 and 18). Snowmachines were used in taking a small percentage of the moose killed in Units 25B and 25D, but the use of snowmachines and boats was probably underrepresented because relatively few harvest reports were submitted by local hunters.

HABITAT

Assessment and Enhancement

Empirical observations and habitat surveys indicate that the upper Yukon River valley provides excellent moose habitat. Moose populations appear to be well below habitat carrying capacity. As in previous years, moose in Unit 25D appeared to be in excellent nutritional condition. Survey personnel often remark on the relatively large size and rounded contours of both adult and calf moose, noting that most calves were as large or larger than those observed in some other areas during late winter.

Habitat surveys indicate that moose browsing intensity is low in both riparian and upland sites and that a large amount of good to high quality forage is available. The occurrence of broomed browse plants is low compared to the Tanana Flats and other areas with high moose densities and/or more limited range (CT Seaton and C Fleener, unpublished data). Feltleaf willow (*Salix alaxensis*) provides high quality food for moose, and is the most common shrub in riparian

habitats. The limited occurrence of moose browsing is reflected in growth form, with extensive stands of 6–50 foot tall feltleaf willows that show little or no evidence of branching due to browsing. Plants only 6–8 feet tall exhibited a mature growth form, also indicating the low intensity of browsing. The mature growth form is rarely observed in young feltleaf willows along the Tanana and Koyukuk Rivers, where moose are more abundant (K Kielland, personal communication).

Other common trees and shrubs, most of which are potential forage species for moose, include sandbar willow (*S. interior*), little tree willow (*S. arbusculoides*), pacific willow (*S. lasiandra*), blueberry willow (*S. nova-anglii/monticola*), diamond leaf willow (*S. pulchra*), fire willow (*S. scouleriana*), bebb willow (*S. bebbiana*), barren ground willow (*S. brachycarpa*), red osier dogwood (*Cornus stolonifera*), balsam poplar (*Populus balsamifera*), and aspen (*P. tremuloides*). The upper Yukon area has the shortest fire cycle in Alaska; extensive fires have created and maintained large areas of good habitat for moose. The low snow accumulation typical of the area is another factor making the Yukon Flats excellent habitat for moose.

CONCLUSIONS AND RECOMMENDATIONS

Recent population surveys indicate that moose numbers continue to be low and have declined in some parts of Unit 25D, although productivity and recruitment are higher than in some other areas in the Interior. Modest progress was made towards achieving management objectives in some areas, and the Yukon Flats Moose Management planning effort is resulting in improvements in population and harvest management. Objectives for Unit 25A were generally met, and the harvest of moose in the remainder of the unit was generally sufficient to satisfy local subsistence needs, as well as provide a moderate amount of hunting for other Alaskans and some nonresidents. Declining moose numbers may result in lower harvests in the future. Revised management goals and objectives for the next reporting period follow. They incorporate goals and objectives developed by the Yukon Flats Moose Management Planning Committee.

MANAGEMENT GOALS

Unit 25 Overall

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.

Unit 25A

- Provide an opportunity to hunt under aesthetically pleasing conditions and provide for subsistence use.

Units 25B and 25D

- Provide for subsistence use and for the greatest opportunity to harvest moose.

- Protect, maintain, and enhance the Yukon Flats moose population and habitat, maintain traditional lifestyles and provide opportunities for use of the moose resource.

- Increase the harvestable surplus of bull moose in key hunting areas near local communities by reducing mortality from bear and wolf predation.

MANAGEMENT OBJECTIVES

Unit 25 Overall

- Double the size of the moose population in key hunting areas and, if possible within the entire planning area, in the next 10 years. A secondary objective is to increase the number of moose in Unit 25D from 4000 moose to 8000 by 2012.

- Maintain a minimum of 40 bulls per 100 cows as observed in fall surveys.

- Improve moose harvest reporting to attain 90% or greater reporting compliance during the next 3 years.

- Minimize cow moose harvest while the population is rebuilding, recognizing that some cows will probably be taken for ceremonial purposes when bull moose are in poor condition.

ACTIVITIES

- Continue efforts to communicate with and educate local residents about moose management and the effects of cow moose harvest.

- Work with natural resource offices in local communities to obtain and exchange information on moose populations and management issues.

- Develop cooperative management programs involving state, federal, and tribal management organizations to help improve local harvest monitoring and reporting.

- Monitor moose population status through annual surveys.

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Table 1 Units 25A and 25B moose observed during early winter aerial composition counts, 1987–1992 (data source: F Mauer, Arctic NWR)

Area/ Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/mi^2
Unit 25A								
1987[a]	63	9	33	25	17	124	149	
1989[b]	75	18	29	52	14	315	367	1.01
1991[c]	55		26	8	16	41	49	
1991[b]	91	13	31	44	14	270	314	0.87
1992[d]				8	15	44	52	
2000[b]	81	21	32	25	14	139	180	
Unit 25B[e]								
1987	119	6	10	6	5	105	111	

[a] Upper Sheenjek River only.
[b] Includes upper Sheenjek and Coleen Rivers.
[c] Observed during moose stratification flights in lower Sheenjek, Coleen, and East Fork Chandalar Rivers.
[d] March 1993 survey in East Fork of Chandalar River drainage around Arctic Village.
[e] The only early winter composition count in this area during regulatory years 1986–2002.

Table 2 Summary of moose population estimates in Unit 25D East, 1995–2001, and 25D West, 1992–2001

Survey year and type	Survey area (mi²)	Strata size (mi²)			Area searched (mi²)			Total search area	No. of moose estimated by strata and total, and density (moose/mi²)			Total estimate @ 90% CI	Average density moose/mi²	No. of sample units counted
		L	M	H	L	M	H		L	M	H			
Eastern 25D														
1995 Regression Analysis	1534	--	--	--	--	--	--	386	--	--	--	704±33%	0.46	28
1997 Regression Analysis	1534	--	--	--	--	--	--	346	--	--	--	625±36%	0.40	27
1999 GSPE[a]	2936	1828	--	1108	175	--	366	541	229/0.13	--	596/0.54	829±20%	0.28	102
2000 GSPE	2936	1639		1297	218		375	594	368/0.22		359/0.28	726±25%	0.25	112
2001 GSPE	2936	1324		1612	186		419	605	52/0.03		487/0.37	514±27%	0.18	115
1999 GSPE	1550	--	--	--	--	--	--	--	--	--	--	516±21%	0.33	
2000 GSPE	1550											385±26%	0.24	
2001 GSPE	1550											305±32%	0.20	
Western 25D														
1992 Stratified Random	4544	3682	515	348	266	379	343	988	77/0.02	220/0.43	228/0.66	619±21%	0.14	76
1992 Stratified Random[b]	1532	1040	308	184	46	247	184	476	92/0.09	143/0.47	154/0.84	455±33%	0.30	37
1996 Regression Analysis	1532	476	516	539	120	122	124	366	--	--	--	666±21%	0.44	27
March 1999 Geo	2269	1714	--	554	253	--	264	517	318/0.19	--	422/0.76	735±17%	0.32	96
1999 GSPE	2269	1444	--	825	156	--	345	501	295/0.20	--	567/0.69	862±19%	0.38	93
2000 GSPE	2269	1281		987	124		371	495	124/0.10		553/0.56	670±24%	0.30	
2001 GSPE	2269	1374		865	205		334	539	161/0.12		506/0.56	668±24%	0.29	100
1999 GSPE	1774											707±19%	0.40	
2000 GSPE	1774											555±24%	0.31	
2001 GSPE	1774	1020		755	156		280	437	104/0.10		428/0.57	543±25%	0.31	

[a] 1999 surveys used smaller sample units, and 2 rather than 3 strata.
[b] Based on sample units counted in the 1992 survey and which later comprised the 1996 survey area.

Table 3 Estimated moose population composition based on 1995, 1997, 1999 and 2000 fall population surveys in Unit 25D East, and results of fall 1992, 1996, 1999 and 2000 surveys in Unit 25D West

Survey period and area (mi²)	Total bulls	Total cows	Total calves	Total adults	Total moose (90% CI)	Bulls: 100 Cows	Yrlg Bulls: 100 Cows	Calves: 100 Cows	% Bulls	% Cows	% Calves	Moose per mi²
Eastern 25D												
Fall 1995 (1534)	199	369	136	568	704±33%	54	8	37	28	52	19	0.46
Fall 1997 (1534)	208	372	45	580	625±36%	56	16	12	33	60	7	0.40
Fall 1999 (2936)	218	381	223	599	829±20%	57	24	59	26	46	27	0.28
Fall 2000 (2936)	252	319	156	571	726±25%	79	19	49	35	44	21	0.25
Fall 2001 (2936)	208	217	93	225	514±27%	95	17	43	40	42	18	0.18
Fall 1999 (1550)	141	246	123	387	516±21%	57	24	50	28	48	24	0.33
Fall 2000 (1550)	135	169	81	304	385±26%	79	19	49	35	44	21	0.24
Fall 2001 (1550)	123	130	54	253	305±32%	95	20	42	40	43	18	0.20
Western 25D												
Fall 1992 (4544)	224	317	78	541	619±21	71	12	25	36	51	13	0.14
Fall 1992 (1531)	134	252	69	386	455±33%	53	9	28	30	55	15	0.30
Fall 1996 (1531)	184	340	142	524	666±21%	54	10	42	28	51	21	0.44
March 1999 (2296)	--	--	64	671	735±17%	--	--	--	--		8.7	0.31
Fall 1999 (2269)	165	529	168	694	862±19%	31	6	31	19	61	20	0.38
Fall 2000 (2269)	247	346	75	593	670±24%	71	12	22	37	52	11	0.30
Fall 2001 (2269)	193	375	100	568	668±24%	52		27	29	56	15	0.29

Table 4 Moose observed in Unit 25D East during early winter moose composition surveys, 1986–2001

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/mi^2
1986	84	13	34	26	15	144	170	0.7
1987	81	18	27	29	13	196	225	0.9
1988[a]								
1989	63	9	41	59	20	235	294	1.0
1990[b]	64	5	32	7	16	36	43	0.7
1991[c]	66	9	26	25	13	168	193	0.7
1992[a]								
1993	38	8	40	37	22	128	165	1.0
1994	68	20	25	24	12	160	184	0.6
1995[d]	50	7	30	39	16	193	232	0.46
1996[e]	54	6	43	16	22	57	73	--
1997[d]	61	18	13	14	8	169	183	0.40
1998[a]								
1999[d]	65	24	45	47	21.5	172	219	0.28
2000[d]	77	19	45	31	20.3	122	153	0.25
2001	103	20	39	26	16	134	160	0.18

[a] No survey.
[b] Poor survey conditions, partial count.
[c] Part of the Graveyard trend area was not completed.
[d] Based on composition observed in population survey, except that estimated density is shown.
[e] Based on limited composition survey in Graveyard and Mardow trend count areas.

Table 5 Unit 25D West moose observed during early winter aerial moose composition counts, 1986–2001

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/mi^2
1986	78	23	27	20	13	132	152	0.42
1987	71	8	25	13	13	87	100	0.57
1988	84	18	29	13	14	83	96	0.55
1989[a]								
1990[b]	44	12	29	4	15	23	27	
1991[c]	98	8	31	15	13	97	112	0.47
1991[d]	146	8	46	6	16	32	38	0.22
1991[e]	81	8	25	9	12	65	74	1.15
1992[f]	71	12	25	48	13	345	393	0.12
1992[g]	70	11	19	5	10	46	51	0.47
1993[h]	51	14	30	17	16	86	103	0.50
1994[i]	115	23	45	9	14	56	65	0.63
1995[a]								
1996[j]	54	11	42	57	17	273	330	0.44
1997[a]				26	10		248	
1998[k]								
1999[j]	32	6	35	56	21	213	269	0.50
2000	64	7	24	28	13	192	220	0.44
2001	45	9	32	49	18	223	272	0.51

[a] No survey.
[b] Poor survey conditions, only Meadow Creek area surveyed.
[c] Includes both low and high elevation surveys.
[d] Includes only low elevation count areas (Meadow Creek and Birch Creek).
[e] Mt Schwatka area only.
[f] Data from Unit 25D West census.
[g] Data from Meadow Creek and Mud Lakes trend areas within census area.
[h] Data from Meadow Creek and Mud Lakes trend areas. Mt Schwatka area not surveyed.
[i] Mud Lakes area not surveyed.
[j] Based on composition observed in early winter population survey.
[k] Composition observed in March 1999 population survey.

Table 6 Unit 25A reported moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory	Reported[a] harvest			
Year	M	F	Unk	Total
1986–1987	47	0	0	47
1987–1988	41	0	0	41
1988–1989	39	0	0	39
1989–1990	25	0	0	25
1990–1991	56	0	0	56
1991–1992	47	0	0	47
1992–1993	17	0	0	17
1993–1994	27	0	0	27
1994–1995	24	0	0	24
1995–1996	37	0	0	37
1996–1997	39	0	0	39
1997–1998	31	0	0	31
1998–1999	47	0	0	47
1999–2000	25	0	0	25
2000–2001	31	0	0	31

[a] Source: moose harvest reports.

Table 7 Unit 25B reported moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory	Reported[a] harvest			
year	M	F	Unk	Total
1986–1987	27	0	0	27
1987–1988	26	0	0	26
1988–1999	28	0	0	28
1989–1990	24	0	0	24
1990–1991	47	0	0	47
1991–1992	32	0	0	32
1992–1993	18	0	0	18
1993–1994	43	0	0	43
1994–1995	33	0	0	33
1995–1996	32	0	0	32
1996–1997	20	0	0	20
1997–1998	21	0	0	21
1998–1999	31	0	0	31
1999–2000	36	0	1	37
2000–2001	37	0	0	37

[a] Source: moose harvest reports.

Table 8 Unit 25D East reported moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory year	Reported[a]			
	M	F	Unk	Total
1986–1987	39	0	0	39
1987–1988	47	0	0	47
1988–1999	32	0	0	32
1989–1990	38	0	0	38
1990–1991	52	0	1	53
1991–1992	29	0	0	29
1992–1993	19	0	0	19
1993–1994	27	1	0	28
1994–1995	27	0	0	27
1995–1996	23	0	0	23
1996–1997	14	0	0	14
1997–1998	19	0	0	19
1998–1999	23	0	0	23
1999–2000	16	0	0	16
2000–2001	18	0	0	18

[a] Source: moose harvest reports.

Table 9 Unit 25D West moose harvest for permit hunt 940 and federal subsistence permits, regulatory years 1989–1990 through 2000–2001

Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Bulls (%)	Cows (%)	Unk (%)	Tier II harvest	Federal permit harvest
1989–1990	50	1 (2)	8 (16)	7 (14)	7 (100)	0 (0)	0 (0)	7	
1990–1991	60	9 (15)	3 (5)	4 (7)	4 (100)	0 (0)	0 (0)	4	11
1991–1992	57	44 (77)	13 (23)	6 (11)	6 (100)	0 (0)	0 (0)	6	8
1992–1993	95	67 (71)	21 (22)	5 (5)	5 (100)	0 (0)	0 (0)	5	4
1993–1994	125	54 (43)	40 (32)	10 (8)	10 (100)	0 (0)	0 (0)	10	0
1994–1995	120	63 (53)	30 (25)	10 (8)	10 (100)	0 (0)	0 (0)	10	2
1995–1996	90	44 (49)	27 (30)	16 (18)	16 (100)	0 (0)	0 (0)	16	1
1996–1997	91	32 (35)	31 (34)	10 (11)	10 (100)	0 (0)	0 (0)	10	7
1997–1998	36	23 (64)	11 (31)	2 (18)	2 (100)	0 (0)	0 (0)	2	13
1998–1999	40	22 (55)	11 (28)	7 (18)	7 (100)	0 (0)	0 (0)	7	20
1999–2000	93	55 (59)	25 (27)	13 (14)	13 (100)	0 (0)	0 (0)	13	17
2000–2001	75	41 (55)	21 (28)	9 (12)	7 (78)	0 (0)	2 (22)	9	7

Table 10 Unit 25A moose hunter residency and success, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Successful					Unsuccessful					Hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1986–1987	4	22	6	5	37 (60)	2	13	10	0	25 (40)	62
1987–1988	4	16	18	3	41 (61)	4	14	3	5	26 (39)	67
1988–1989	3	19	11	6	39 (59)	2	15	9	3	29 (41)	68
1989–1990	3	12	10	0	25 (52)	4	14	5	0	23 (48)	48
1990–1991	5	27	22	2	56 (72)	1	16	5	0	22 (28)	78
1991–1992	4	21	22	0	47 (57)	0	22	13	0	35 (43)	82
1992–1993	2	7	7	1	17 (35)	5	20	6	0	31 (65)	48
1993–1994	3	13	10	1	27 (51)	0	18	8	0	26 (49)	53
1994–1995	1	14	8	1	24 (55)	2	13	5	0	20 (46)	44
1995–1996	6	11	20	0	37 (62)	2	11	10	0	23 (38)	60
1996–1997	1	6	32	0	39 (58)	2	16	9	1	28 (42)	67
1997–1998	3	13	13	2	31 (61)	0	11	9	0	20 (39)	51
1998–1999	4	17	24	2	47 (64)	0	20	7	0	27 (36)	74
1999–2000	3	4	17	0	24 (45)	3	19	7	0	29 (55)	53
2000–2001	1	15	15	0	31 (37)	0	31	21	0	52 (63)	83

[a] Source: moose harvest reports.
[b] Resident of Unit 25.

Table 11 Unit 25B moose hunter residency and success, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Successful					Unsuccessful					Hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1986–1987	9	10	3	5	27 (47)	6	18	2	5	31 (54)	58
1987–1988	9	10	1	6	26 (53)	5	9	6	3	23 (47)	49
1988–1989	9	9	8	2	28 (50)	2	20	6	0	28 (50)	56
1989–1990	7	16	1	0	24 (40)	9	24	1	2	36 (60)	60
1990–1991	9	31	5	2	47 (57)	9	25	2	0	36 (43)	83
1991–1992	9	17	4	2	32 (46)	12	22	4	0	38 (54)	70
1992–1993	6	9	2	1	18 (19)	7	61	4	3	75 (81)	93
1993–1994	13	24	6	0	43 (52)	4	29	5	1	39 (48)	82
1994–1995	6	19	5	3	33 (34)	5	39	14	6	64 (66)	97
1995–1996	6	24	2	0	32 (40)	2	37	9	1	49 (60)	81
1996–1997	6	10	3	1	20 (29)	5	36	7	1	49 (71)	69
1997–1998	7	11	3	0	21 (34)	4	29	8	0	41 (66)	62
1998–1999	10	18	3	0	31 (53)	3	20	2	2	27 (47)	58
1999–2000	7	29	1	0	37 (41)	8	40	5	0	53 (59)	90
2000–2001	5	25	4	0	34 (48)	1	34	2	0	37 (52)	71

[a] Source: moose harvest reports.

[b] Resident of Unit 25.

Table 12 Unit 25D East moose hunter residency and success, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Successful					Unsuccessful					Hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1986–1987	23	10	1	5	39 (42)	29	22	1	1	53 (58)	92
1987–1988	24	16	6	1	47 (53)	22	13	3	3	41 (47)	88
1988–1989	18	5	4	5	32 (47)	19	8	4	5	36 (53)	68
1989–1990	24	11	2	1	38 (44)	24	20	5	0	49 (56)	87
1990–1991	35	17	0	1	53 (46)	31	26	4	1	62 (54)	115
1991–1992	17	11	1	0	29 (32)	31	31	0	0	62 (68)	91
1992–1993	10	8	1	0	19 (23)	31	31	3	0	65 (77)	84
1993–1995	14	10	3	1	28 (36)	22	24	0	3	49 (64)	77
1994–1996	16	9	0	2	27 (30)	29	31	3	0	63 (70)	90
1995–1996	17	5	1	0	23 (29)	13	35	7	1	56 (71)	79
1996–1997	7	6	1	0	14 (23)	18	25	4	1	48 (77)	62
1997–1998	13	11	2	0	26 (27)	15	50	5	0	70 (73)	96
1998–1999	13	9	1	0	23 (31)	22	24	5	0	51 (69)	74
1999–2000	5	11	0	0	16 (24)	21	25	4	0	50 (76)	66
2000–2001	3	8	1	6	18 (25)	6	38	9	0	53 (75)	72

[a] Source: moose harvest reports.
[b] Resident of Unit 25.

Table 13 Unit 25A reported moose harvest chronology[a] percent by month/day, regulatory years 1986–1987 through 2000–2001

Regulatory year	Harvest chronology percent by month/day						
	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5[b]	Unk	*n*
1986–1987	32	43	13	11		2	47
1987–1988	12	34	34	17		2	41
1988–1989	10	54	31	3		3	39
1989–1990	20	36	40	4		0	25
1990–1991	21	54	20	4		2	56
1991–1992	19	43	32	2		4	47
1992–1993	12	41	35	12			17
1993–1994	30	48	19	4		0	27
1994–1995	44	52	4	0		0	24
1995–1996	35	38	16	8		3	37
1996–1997	33	23	35	8		0	39
1997–1998	3	23	39	26		9	31
1998–1999	28	36	30	2		4	47
1999–2000	12	48	28	4		8	25
2000–2001	16	48	29	6		0	31

[a] Source: moose harvest reports.
[b] No open season.

Table 14 Unit 25B reported moose harvest chronology[a] percent by month/day, regulatory years 1986–1987 through 2000–2001

Regulatory year	Harvest chronology percent by month/day							
	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Dec	Unk	*n*
1986–1987	7	22	52	7	–[b]	0	11	27
1987–1988	8	19	39	19	4[b]	8	4	26
1988–1989	4	41	44	4	–[b]	4	4	27
1989–1990	8	21	42	13	–[b]	17	0	24
1990–1991	11	28	34	13	2	11	2	47
1991–1992	3	41	38	13	0	3	3	32
1992–1993	11	44	17	0	0	28	0	18
1993–1994	12	33	35	12	0	7	2	43
1994–1995	3	38	44	13	0	3	0	33
1995–1996	28	38	25	3	0	6	0	32
1996–1997	25	35	15	5	0	10	10	20
1997–1998	5	5	29	29	19	10	5	21
1998–1999	10	32	39	10	0	6	3	31
1999–2000	8	32	27	11	0	0	22	37
2000–2001	27	11	35	16	0	8	3	37

[a] Source: moose harvest reports.
[b] No open season.

Table 15 Unit 25D East reported moose harvest chronology[a] percent by month/day, regulatory years 1986–1987 through 2000–2001

Regulatory year	Harvest chronology percent by month/day							
	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Dec	Unk	*n*
1986–1987	0	56	31	3	–[b]	8	3	39
1987–1988	0	20	53	13	–[b]	7	7	45
1988–1989	0	47	31	3	3	13	3	32
1989–1990	0	45	24	11	3	13	3	38
1990–1991	8	37	40	2	2	6	6	52
1991–1992	17	55	24	3	0	0	0	29
1992–1993	0	42	53	5	0	0	0	19
1993–1994	18	32	29	0	4	11	7	28
1994–1995	8	54	27	8	0	0	0	27
1995–1996	13	43	35	0	0	4	4	23
1996–1997	7	50	29	0	0	0	14	14
1997–1998	0	5	47	37	11	0	0	19
1998–1999	17	57	22	4	0	0	0	23
1999–2000	6	50	31	13	0	0	0	16
2000–2001	5	56	33	0	0	0	5	18

[a] Source: moose harvest reports.
[b] No open season.

Table 16 Unit 25A moose harvest percent by transport method, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Harvest percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
1986–1987	72	17	8	0	0	0	0	2	47
1987–1988	61	12	17	0	0	0	2	7	41
1988–1989	61	17	20	0	0	0	5	5	41
1989–1990	56	16	24	0	0	0	4	0	25
1990–1991	61	11	27	0	0	0	0	2	56
1991–1992	77	15	9	0	0	0	0	0	47
1992–1993	76	6	12	0	0	0	0	6	17
1993–1994	56	26	15	0	0	0	4	0	27
1994–1995	75	4	13	0	0	0	9	0	24
1995–1996	62	16	16	0	0	0	3	3	37
1996–1997	69	28	2	0	0	0	0	0	39
1997–1998	65	6	26	0	0	0	3	0	31
1998–1999	68	15	17	0	0	0	0	0	47
1999–2000	64	20	16	0	0	0	0	0	25
2000–2001	77	6	16	0	0	0	0	0	31

[a] Source: moose harvest reports.

Table 17 Unit 25B moose harvest percent by transport method, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1986–1987	30	0	63	0	0	0	0	7	27
1987–1988	27	0	65	0	4	0	0	4	26
1988–1989	29	0	61	0	4	0	0	7	28
1989–1990	21	0	75	0	0	0	0	4	24
1990–1991	23	0	68	0	6	2	0	0	47
1991–1992	9	0	78	0	0	0	0	12	32
1992–1993	22	6	61	0	11	0	0	0	18
1993–1994	12	2	77	2	2	2	0	2	43
1994–1995	22	0	73	0	0	0	0	6	33
1995–1996	9	3	75	3	3	0	0	6	32
1996–1997	15	5	75	0	0	0	0	5	20
1997–1998	14	5	71	0	0	0	10	0	21
1998–1999	13	3	81	3	0	0	0	0	31
1999–2000	8	3	73	5	3	0	3	5	37
2000–2001	11	3	81	0	3	0	0	3	37

[a] Source: moose harvest reports.

Table 18 Unit 25D East moose harvest percent by transport method, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1986–1987	13	0	67	0	5	0	3	13	39
1987–1988	17	0	66	0	6	0	2	8	47
1988–1989	28	0	47	0	16	0	0	9	32
1989–1990	26	0	51	0	13	0	3	8	39
1990–1991	26	0	64	2	2	0	0	6	53
1991–1992	21	0	72	0	0	7	0	0	29
1992–1993	42	0	53	0	0	5	0	0	19
1993–1994	14	0	75	0	4	0	0	7	28
1994–1995	8	0	78	4	0	0	0	11	27
1995–1996	26	0	61	0	0	0	4	9	23
1996–1997	21	0	71	0	0	0	0	7	14
1997–1998	11	0	84	5	0	0	0	0	19
1998–1999	13	0	74	4	0	4	4	0	23
1999–2000	25	0	63	0	0	6	6	0	16
2000–2001	17	0	78	0	5	0	0	0	18

[a] Source: moose harvest reports.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: Units 26B and 26C (26,000 mi^2)

GEOGRAPHIC DESCRIPTION: North Slope of the Brooks Range and Arctic Coastal Plain east of the Itkillik River

BACKGROUND

Moose were scarce in Arctic Alaska prior to the early 1950s, when populations expanded and reached high densities in the limited riparian habitat of major drainages (LeResche et al. 1974). Predation, as well as hunting, probably contributed to the historical scarcity of moose. The reduction in wolf numbers by federal control programs during the late 1940s and early 1950s was likely important in allowing moose populations to increase and become established in most of the riparian shrub habitat on the North Slope. Aerial wolf hunting during the decade following statehood also limited wolf populations.

This area represents the northern limit of moose range in North America. Thus, habitat severely limits the potential size of moose populations, and the concentrated nature of moose distribution and open habitat creates the potential for excessive harvests in accessible areas. During the early 1990s, concentration of hunting pressure along these drainages caused concern among guides, outfitters, hunters, and Alaska Department of Fish and Game (ADF&G) and Arctic National Wildlife Refuge staff. Moose hunting regulations became increasingly restrictive during the past decade and a precipitous decline in numbers of moose led to a season closure in 1996.

Kaktovik and Nuiqsut are the only subsistence communities in the area, and residents took 2–6 moose annually prior to the season closure in 1996. Subsistence harvest was small because moose are scarce near Kaktovik and because most hunting by Nuiqsut residents occurred in the Colville River drainage in adjacent Unit 26A.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Maintain viable populations of moose in their historic range throughout the region.

- Provide a sustained opportunity to harvest moose.

- Provide opportunity for viewing and photographing moose.

MANAGEMENT OBJECTIVES

- In Unit 26B East, allow the moose population to increase to at least 200 moose, with at least 15% calves in spring surveys, before reopening the hunting season.

- In Unit 26B West, allow the moose population to increase to at least 75 moose, with at least 15% calves in spring surveys, before reopening the hunting season.

- Once a hunting season has been reopened, maintain a posthunting sex ratio in Units 26B and 26C of 35 bulls:100 cows.

METHODS

The limited and relatively open nature of winter moose habitat on the North Slope makes a total count in trend count areas, rather than random sampling, the most effective population survey method. Moose are limited almost entirely to riparian shrub habitat during winter. Historically, surveys were conducted in Unit 26B East (east of the east bank of the Sagavanirktok, including the Canning River) and in Unit 26C along the Kongakut and Firth Rivers and Mancha Creek. The west bank of the Canning River is the boundary between Units 26B and 26C. However, Unit 26B East survey data includes moose counted in the Canning River portion of Unit 26C. Surveys in Unit 26B West (west of the east bank of the Sagavanirktok) have also been conducted since 1970. Standard surveys began in 1996 and historical data were reanalyzed to allow a comparison with recent data. Moose inhabit different terrain in Unit 26B East and Unit 26B West. Unit 26B East moose are found primarily in the northern foothills of the Brooks Range while in Unit 26B West moose are found along major drainages on the coastal plain.

The US Fish and Wildlife Service conducted moose composition surveys of riparian willow habitat in Unit 26B East (Martin and Garner 1984; Weiler and Liedberg 1987; Mauer and Akaran 1994; Mauer 1995, 1997). Surveys were done during the end of October, early November, April, or May using Piper PA-18 aircraft flown at 70–90 mph, and/or a Cessna 185 flown at 95–120 mph, at altitudes of 300–600 feet above ground level. The following drainages were surveyed as weather permitted: Accomplishment Creek, Lupine River, Saviukviayak River, Flood Creek, Ivishak River, Gilead Creek, Echooka River, Shaviovik River, Juniper/Fin Creek, Kavik River, and Canning River. Aerial observers circled each moose and, during fall surveys, classified moose as calves, cows, yearling bulls, medium bulls (≤50 inch antlers), or large bulls (>50 inch antlers). Medium and large bulls were combined in this report. Spring surveys were completed in 1999, 2000, and 2001 because low snowfall and poor weather precluded fall surveys. The Alaska Department of Fish and Game conducted the survey in spring 2002 and moose were classified as short yearlings and adult bulls and cows. Because the 2002 survey was conducted in early May, we were able to obtain a minimum estimate of bull:cow and calf:cow ratios.

We conducted spring moose surveys in Unit 26B West in April 1997 and during 1999–2002, using the methods described previously. Surveys were conducted along riparian willow habitat on the Sagavanirktok River from Happy Valley to Sagwon Bluffs and on the Toolik and Kuparuk Rivers starting at approximately latitude 68°52'W to the White Hills. In addition, parts of the Itkillik River have been surveyed periodically since 1981 but because of incomplete surveys during 1996–2002, these data are treated separately.

We conducted habitat reconnaissance in Unit 26B East during the last week of April 1994, in cooperation with the US Fish and Wildlife Service and University of Alaska. Availability, condition, and species composition of moose browse were evaluated along parts of Accomplishment Creek, Section Creek, and the upper Lupine River.

The hunting season has been closed since fall 1996. Prior to the closure, harvest and hunting pressure were monitored using harvest reports submitted by hunters. Reminder letters were sent to hunters who did not report after the fall season. Population surveys, total harvest, residency and success, chronology, and transportation data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY99 = 1 Jul 1999–30 Jun 2000). Informal visits and interviews with hunters and guides also provided insight into population status and moose management issues.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

A complete moose population survey has not been conducted in Units 26B and 26C, but the nature of terrain and sparse, low vegetation makes it possible for trend surveys to account for a large percentage of the moose in areas supporting major concentrations.

In Unit 26B East, the highest numbers of moose observed were 621 in fall 1986 and 629 in fall 1988 (Table 1). Beginning in fall 1990, the number of moose observed declined markedly to 381 moose and continued to decline to 141 moose by fall 1996. The lowest number of 97 moose observed in fall 1997 should be viewed as an underestimate because 25% of the Canning River was not surveyed. Since 1997, surveys have been conducted in the spring and the population appears to have stabilized at about 160 moose (Table 1). During recent surveys the highest concentrations of moose were found along the Echooka, Ivishak, Kavik, and Canning Rivers. When moose numbers were higher, concentrations also were found along Juniper, Fin, and Gilead Creeks.

Based on earlier surveys in Unit 26B West, it appears that moose numbers increased from approximately 100 moose to 165 moose during 1977 through 1984. The surveys conducted in 1984 and 1989 are comparable to standard surveys that began in spring 1996 (Table 2). Moose numbers appeared to be relatively stable during the mid-to-late 1980s at approximately 150 moose (Table 2). Information from harvest data, hunting guides, and bush pilots indicated that the moose population in this area declined during the early 1990s, just as it did in Units 26A and 26C. A survey was not conducted until spring 1996 when 53 moose were observed. Surveys

conducted during 1999–2000 indicated a stable population of 50 moose with an increase to 70 moose observed in 2001 and 67 in 2002 (Table 2). This followed the same trend observed in Unit 26B East, where it appeared that the population was relatively stable during RY95–RY01. Most of the moose observed in Unit 26B West were found in the Kuparuk drainage.

Spring surveys conducted along the Itkillik River from the mid 1980s to the mid 1990s indicated moose numbers were stable at about 45 moose (ADF&G files). Although moose did not appear to decline in the early 1990s, as observed elsewhere, we observed only 27 moose in 1999 and 9 in 2002. Either no surveys or incomplete surveys were conducted in 1996, 1997, 1998, and 2001.

The decline in moose numbers in the early 1990s appeared to be widespread on the eastern North Slope, as well as in Unit 26A (Carroll 1998). Calf survival was very low during 1993–1996 (Tables 1 and 2; Carroll 1998) and during summer 1995, carcasses of adult moose were found along the Colville River and its tributaries in Unit 26A (Carroll, ADF&G, personal communication). Necropsies revealed that wolves and bears had not killed these moose. Disease may have been involved because in 1996 and 1997, the bacterial diseases brucellosis and leptospirosis were found in 8 of 43 and 6 of 43 (respectively) live moose that were captured and radiocollared. In addition, a marginal copper deficiency was reported in many of the live and dead moose sampled. Thus, it is possible that disease increased vulnerability to poor environmental conditions during the early 1990s. Winters were long in 1993–1994 and 1994–1995, subjecting moose to shorter growing seasons. Also, in summer 1995 there were numerous reports of intense harassment of moose by mosquitoes (however, there is no documentation that moose are negatively impacted by mosquitoes). Disease may have also increased vulnerability to predation. Wolves and grizzly bears were common in the region, particularly in the mountains and northern foothills of the Brooks Range, and incidental observations by biologists, hunters, and pilots suggested that wolf numbers increased during the early 1990s. There was some postulation that range deterioration may have been involved. During the late 1980s, moose were at the highest densities observed on the North Slope. At the same time the moose were declining, there was a population explosion of snowshoe hares in some drainages in eastern Unit 26A (G Carroll, ADF&G, personal communication). This may have created some competition by affecting the quality of browse. However, habitat reconnaissance east of the Dalton Highway in Unit 26B in April 1994 indicated forage was not in critically short supply even though browsing intensity on favored vegetation was relatively heavy. Species composition consisted mostly of *Salix alaxensis* and *S. pulchra,* with the former predominating. Some current annual growth remained; therefore some moose browse was still available. Quality of browse was not determined, but *Salix alaxensis* is among the highest quality browse species and the one often favored by moose in Alaska. We assume disease, predation, weather, insect harassment, and range deterioration may all have been involved.

In eastern Unit 26C, sizable concentrations of moose were surveyed during fall 1990 and 1992 in the Kongakut and Firth Rivers and Mancha Creek. However, no surveys have been completed recently and the status of these moose populations is unknown. A large proportion of the moose in these areas are migratory, moving south and east to the Old Crow Flats in Canada during spring and summer (Mauer 1998).

Population Composition

In Unit 26B East survival of calves to fall was relatively high (12–14%) from 1988–1991 except in 1989 (5%). No surveys were conducted during RY92 and RY93 and by fall 1994, when the number of moose observed had declined dramatically, survival of calves to fall was very low (4%, Table 1). Low calf survival also occurred in 1995 (5%).

Because no surveys were conducted during the 2 years prior to fall 1994, we do not know precisely when calf survival declined. However, a similar pattern was observed during spring surveys in 1994 in Unit 26A, where numbers of observed moose and survival of short yearlings declined sharply (G Carroll, ADF&G, personal communication). Data from Unit 26A indicate that poor calf survival in Unit 26B began sometime between fall 1993 and spring 1994.

Survival of calves to fall improved in 1996 (11%) and 1997 (14%, Table 1). Fall surveys were not conducted during 1998 and 1999, but 13% short yearlings were observed during spring surveys in 1999 and 8% short yearlings were observed in 2000 (Table 1). Short yearlings were not classified in 2001 but we observed 13% short yearlings in 2002 (Table 1). The lowest value of 8% for short yearlings in spring 2000 may have been partly a result of problems with survey methods. Some short yearlings may have been misidentified as adults because observers did not circle and closely examine each moose.

In Unit 26B East bull:cow ratios were below the management objective of 50:100 during fall 1994; but ranged from 61 to 69 during fall 1995–1997 (Table 1). Although bull:cow ratios were high during this time, the population was declining. This suggested that adult cow mortality was higher than adult bull mortality, at least during RY95. However, the season was closed to hunting in fall 1996 and high bull:cow ratios in fall 1996 and 1997 probably resulted from the closed season. We observed a high bull:cow ratio of 72:100 during the 2002 spring survey. This is likely somewhat conservative because we misclassified those young bulls lacking early antler development as cows.

In Unit 26B West (excluding the Itkillik drainage) percent short yearlings was very low in spring 1996 (2%). It increased to 23% in 2000, was again low in 2001 (7%), and was relatively high in 2002 (16%; Table 2). In 2002, percent short yearlings in Unit 26B West was slightly higher than in Unit 26B East (16% and 13%, respectively). It is possible that predation by wolves and/or grizzly bears may be higher on the east side because it is more mountainous and therefore better habitat for bears and wolves.

During the 2002 spring survey we observed a bull:cow ratio of 34:100. As was suggested for Unit 26B East, it is possible the bull:cow ratio was higher because we probably misclassified some young bulls as cows. However, the bull:cow ratio was substantially lower than that observed in Unit 26B East. Although we have no data on movements, it is likely that some bulls leave Unit 26B West after the rut and winter in the foothills in Unit 26B East. Data from the 1984 spring survey indicated a bull:cow ratio of 30:100 (ADF&G files), similar to that observed in 2002, although harvest would have influenced the composition observed in 1984.

Distribution and Movements

Moose were generally associated with narrow strips of shrub communities along drainages, except in summer when some dispersal occurred. Historically, the greatest concentrations occurred along the Canning, Kavik, Ivishak, Toolik, Kuparuk, Itkillik, and Kongakut Rivers and Juniper and Fin Creeks. Few moose have been observed on the Itkillik River and no surveys have been conducted on the Kongakut River in recent years. Moose movements have not been intensively studied, but casual observations indicate there may be seasonal movements within or between North Slope drainages. Telemetry studies show that some moose winter in the upper Kongakut River and migrate south and east to summer on the Old Crow Flats in Canada (Mauer 1998).

MORTALITY

Harvest

Season and Bag Limit. There was no open season for moose in Units 26B and 26C during RY96–RY99.

Alaska Board of Game Actions and Emergency Orders. The following is a review of previous regulations and regulatory changes. During RY90–RY94 the season for Units 26B and 26C was 5–15 September for both residents and nonresidents, with a bag limit of 1 bull. A 50-inch minimum antler size requirement was in effect for nonresidents and also for anyone hunting within the Dalton Highway Corridor Management Area (DHCMA; see below). During RY90–RY92 the definition of a 50-inch moose was an antler width ≥ 50" or 3 or more brow tines on one side. In RY93 the definition was changed for moose north of the Alaska Range to a bull with antlers at least 50 inches or 4 or more brow tines on one side. An additional season of 1 November–31 December, with a bag limit of 1 bull with antlers at least 50 inches or 4 or more brow tines on one side, was open to residents during RY90–RY94.

In RY95 the season remained the same for Unit 26B and the Canning River drainage, part of which is in Unit 26C. The season for residents and nonresidents in Unit 26C East of the Canning River drainage was 5–15 September with a bag limit of 1 bull. The previous antler restriction for nonresidents was inadvertently eliminated due to an error in a proposal that was submitted to the Board of Game in 1994. The winter season for residents was changed to 1–31 December.

State regulations governed moose hunting along the Dalton Highway in Unit 26B through RY95. The DHCMA extends 5 miles from each side of the Dalton Highway from the Yukon River to the Prudhoe Bay Closed Area. The DHCMA was closed to hunting with firearms. However, big game, small game, and fur animals could be taken by bow and arrow. Hunters had to possess a valid International Bow Hunter Education card. In addition, no motorized vehicles, except aircraft, boats and licensed highway vehicles could be used to transport game or hunters.

The season was closed during RY96 because of a decline in moose numbers and has remained closed through RY00. During their March 2000 meeting, the board determined that a harvest of 60–80 moose was necessary to satisfy subsistence needs in Unit 26.

There has not been an open season on federal lands in Units 26B and 26C in federal regulations since RY96. However, federal subsistence hunting regulations applied to federal lands during RY90–RY95 (RY90 was the first year of federal implementation). In RY90 any rural resident was eligible to hunt, even if they did not live near the resource. Since then, only residents of the corridor and nearby villages (Anaktuvuk Pass, Wiseman, Nuiqsut, and Kaktovik) have been eligible. In RY92–RY93, federal regulations allowed the use of firearms for hunting on federal land within the DHCMA by qualified rural subsistence hunters.

During the March 2002 meeting the Board of Game considered a number of proposals related to bow hunting and the use of motorized vehicles in the DHCMA, some of which may affect moose hunting when it is reopened. The board established the North Slope Closed Area, which is closed to big game hunting. The area includes the portion of Unit 26B within ¼ mile of the Dalton Highway from Atigun Pass north to the Prudhoe Bay Closed Area. The board also established a requirement that hunters using the DHCMA mark arrows with their bow hunter education certification number, extended the restrictions on the use of motorized vehicles in the DHCMA to apply to the Prudhoe Bay Closed Area, and limited the use of licensed highway vehicles in the DHCMA to publicly maintained roads.

Hunter Harvest. The reported moose harvest in Unit 26B was relatively stable during the early 1990s, ranging from 24–37, except in RY92 when harvest was 45 (Table 3). In RY95 harvest declined to 16 animals. The number of hunters increased markedly from 49 in RY91 to 90 in RY92. The number of moose hunters remained high during the following 3 years (63–90), but harvest declined (range = 16–37) to previous levels, probably reflecting the declining moose population.

In Unit 26C the harvest was 3–6 and the number of hunters was 5–12 during RY90–RY95 (Table 4). Compared with Unit 26B, fewer hunters reported hunting in Unit 26C, probably because of a lack of airstrips near moose habitat in Unit 26C and the small number of moose in the area during fall. Most of the hunting in Unit 26C occurred in the Canning River drainage.

Hunter Residency and Success. During RY86–RY96, Alaska residents living outside the area comprised all but a few of the resident hunters in Units 26B and 26C (Table 5). Hunter success declined to below 50% beginning in RY93, likely due to the declining moose population. Nonresidents reported a higher success rate than Alaska residents, probably because many nonresidents benefited from guide/outfitter services.

Harvest Chronology. During RY86–RY96 most moose harvested in Units 26B and 26C were taken during the first 2 weeks of September (Table 6). The concentration of hunting activity in early autumn was likely due to early onset of winter in the region.

Transport Methods. During RY86–RY96, aircraft was the predominant transportation method for hunters; being used by over 70% of the successful moose hunters (Table 7).

Natural Mortality

No intensive studies of moose mortality have been done in the eastern Arctic. The decline in the early 1990s was probably due to a combination of natural mortality factors including the

bacterial diseases brucellosis and leptospirosis, copper deficiency, weather, insect harassment, competition with snowshoe hares, and predation from bears and wolves.

There is some evidence that recent mortality rates for adult female moose have been low. In Unit 26A along the Colville River, the mortality rate for radiocollared moose was 5.7% for 1996–1997, 2.1% for 1997–1998, 0% for 1998–1999, and 11.9% for 1999–2000.

CONCLUSIONS AND RECOMMENDATIONS

The moose population in Units 26B and 26C declined dramatically during the early 1990s, but has been fairly stable, and may have increased slightly, since RY95 (Tables 1 and 2). A combination of factors including disease, weather, habitat limitations, insect harassment, and increased predation by wolves and grizzly bears were possibly responsible for the decline. There is some indication that percent short yearlings may be stable in Unit 26B East, although it is difficult to determine the trend because no survey data are available for 2001. Also, there is a possibility that the proportion of short yearlings was underestimated in 2000. Percent short yearlings in Unit 26B West appears to have improved, although we observed a low value in 2001. Similar trends in moose numbers and composition in the early 1990s and a subsequent slow recovery have also been observed in Unit 26A.

We met our first goal of maintaining viable populations of moose in their historic range throughout the region, in part by continuing to keep the hunting season closed until the moose population recovers and our management objectives are met. We did not meet our second goal of providing an opportunity to harvest moose because moose numbers were too low. Moose were available for viewing and photographing, our third goal.

We are approaching our population objective of at least 200 moose in Unit 26B East and 75 moose in Unit 26B West. We are also approaching our objective of ≥15% calves in April or May surveys When these objectives are met, we will propose to open the hunting season. Our third objective is to maintain a posthunting sex ratio of 35 bulls:100 cows for Units 26B and 26C. Spring 2002 surveys indicated that bull:cow ratios were higher than our objective.

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Table 1 Unit 26B East (east of Dalton Highway, including Canning River) aerial moose composition counts, regulatory years 1988–1989 through 2001–2002[a]

Regulatory year	Season	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed
1986–1987[b]	Fall	57	NA	29	87	15	477	564
1987–1988[c]								
1988–1989	Fall	59	30	21	75	12	554	629
1989–1990	Fall	54	13	9	32	5	568	600
1990–1991[d]	Fall	59	7	26	63	14	383	446
1991–1992[d]	Fall	47	9	21	66	15	452	518
1992–1993[c]								
1993–1994[c]								
1994–1995	Fall	39	8	5	14	4	367	381
1995–1996	Fall	66	11	8	7	5	138	145
1996–1997	Fall	61	5	22	16	11	125	141
1997–1998	Fall	69	4	30	14	14	83	97
1998–1999	Spring				20	13	129	149
1999–2000[e]	Spring				14	8	151	165
2000–2001	Spring							146
2001–2002[f]	Spring	72	na	28	22	13	148	170

[a] Data source for 1988–1989 through 2000–2001: F Mauer, US Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks.
[b] Modified from Weiler and Leidberg 1987.
[c] No survey.
[d] Incomplete survey. Approximately 27% and 19% of total area was not surveyed in fall 1990 and fall 1991, respectively.
[e] Moose were not circled and examined closely, so some calves may have been identified as cows.
[f] Data collected by ADF&G.

Table 2 Unit 26B West (Kuparuk and Toolik Rivers and Sagavanirktok River from Happy Valley to Sagwon Bluffs) spring aerial moose surveys, regulatory years 1983–1984 through 2001–2002

Regulatory year	Short yearlings	Percent short yearlings	Adults	Moose observed
1983–1984	32	19	133	165
1984–1985 through 1987–1988[a]				
1988–1989[a]	18	12	131	149
1989–1990 through 1994–1995[a]				
1995–1996	1	2	52	53
1996–1997 through 1997–1998[a]				
1998–1999	6	11	50	56
1999–2000	10	23	34	44
2000–2001	5	7	65	70
2001–2002[b]	11	16	56	67

[a] No survey.
[b] The Sagavanirktok River was not surveyed.

Table 3 Unit 26B reported moose harvest and accidental death, regulatory years 1988–1989 through 2001–2002

Regulatory year	Reported harvest				Hunters
	M (%)	F (%)	Unk	Total	
1988–1989	33 (100)	0 (0)	0	33	49
1989–1990	24 (100)	0 (0)	1	25	47
1990–1991	24 (100)	0 (0)	0	24	45
1991–1992	28 (100)	0 (0)	0	28	49
1992–1993	45 (100)	0 (0)	0	45	90
1993–1994	30 (100)	0 (0)	0	30	84
1994–1995	37 (100)	0 (0)	0	37	85
1995–1996	16 (100)	0 (0)	0	16	63
1996–1997 through 2001–2002[a]					

[a] No open season.

Table 4 Unit 26C reported moose harvest and accidental death, regulatory years 1988–1989 through 2001–2002

Regulatory year	Reported harvest				
	M (%)	F (%)	Unk	Total	Hunters
1988–1989	10 (100)	0 (0)	0	10	18
1989–1990	1 (100)	0 (0)	0	1	11
1990–1991	3 (100)	0 (0)	0	3	8
1991–1992	6 (100)	0 (0)	0	6	11
1992–1993	4 (100)	0 (0)	0	4	5
1993–1994	4 (100)	0 (0)	0	4	7
1994–1995	6 (100)	0 (0)	0	6	12
1995–1996	4 (100)	0 (0)	0	4	8
1996–1997 through 2001–2002[a]					

[a] No open season.

Table 5 Units 26B and 26C moose hunter residency and success, regulatory years 1988–1989 through 2001–2002[a]

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1988–1989	0	13	26	4	43 (64)	0	14	6	4	24 (36)	67
1989–1990	0	11	15	0	26 (45)	0	24	7	1	32 (55)	58
1990–1991	0	7	18	2	27 (51)	0	21	5	0	26 (49)	53
1991–1992	1	11	19	3	34 (57)	1	13	10	2	26 (43)	60
1992–1993	0	23	25	1	49 (52)	0	43	2	1	46 (48)	95
1993–1994	2	23	8	1	34 (37)	1	44	11	1	57 (63)	91
1994–1995	0	24	19	0	43 (44)	2	34	15	3	54 (56)	97
1995–1996	0	3	17	0	20 (28)	2	34	17	0	51 (72)	71
1996–1997 through 2001–2002[c]											

[a] Source: moose harvest reports.
[b] Residents of Units 26B or 26C.
[c] No open season.

Table 6 Units 26B and 26C moose harvest chronology percent by time periods, regulatory years 1988–1989 through 2001–2002[a]

Regulatory year	Harvest chronology percent by time periods								
	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Oct	Nov	Dec	*n*
1988–1989	42	25	22	11					36
1989–1990	27	31	31	4	4				26
1990–1991	37	52	4					2	27
1991–1992	53	41						6	34
1992–1993	63	37							49
1993–1994	50	44	3					3	34
1994–1995	54	44	3					2	41
1995–1996	37	53	10						19
1996–1997 through 2001–2002[b]									

[a] Source: moose harvest reports.
[b] No open season.

Table 7 Units 26B and 26C moose harvest percent by transport method, regulatory years 1988–1989 through 2001–2002[a]

Regulatory year	Harvest percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
1988–1989	83	2	5	0	2	0	7		41
1989–1990	96	0	4	0	0	0	0		26
1990–1991	75	4	21	0	0	0	0		24
1991–1992	76	0	15	0	6	0	0	3	34
1992–1993	84	0	8	0	0	0	8	0	49
1993–1994	71	0	21	0	3	0	6	0	34
1994–1995	74	0	19	0	2	0	5	2	43
1995–1996	90	0	0	0	0	0	10	0	20
1996–1997 through 2001–2002[b]									

[a] Source: moose harvest reports.
[b] No open season.